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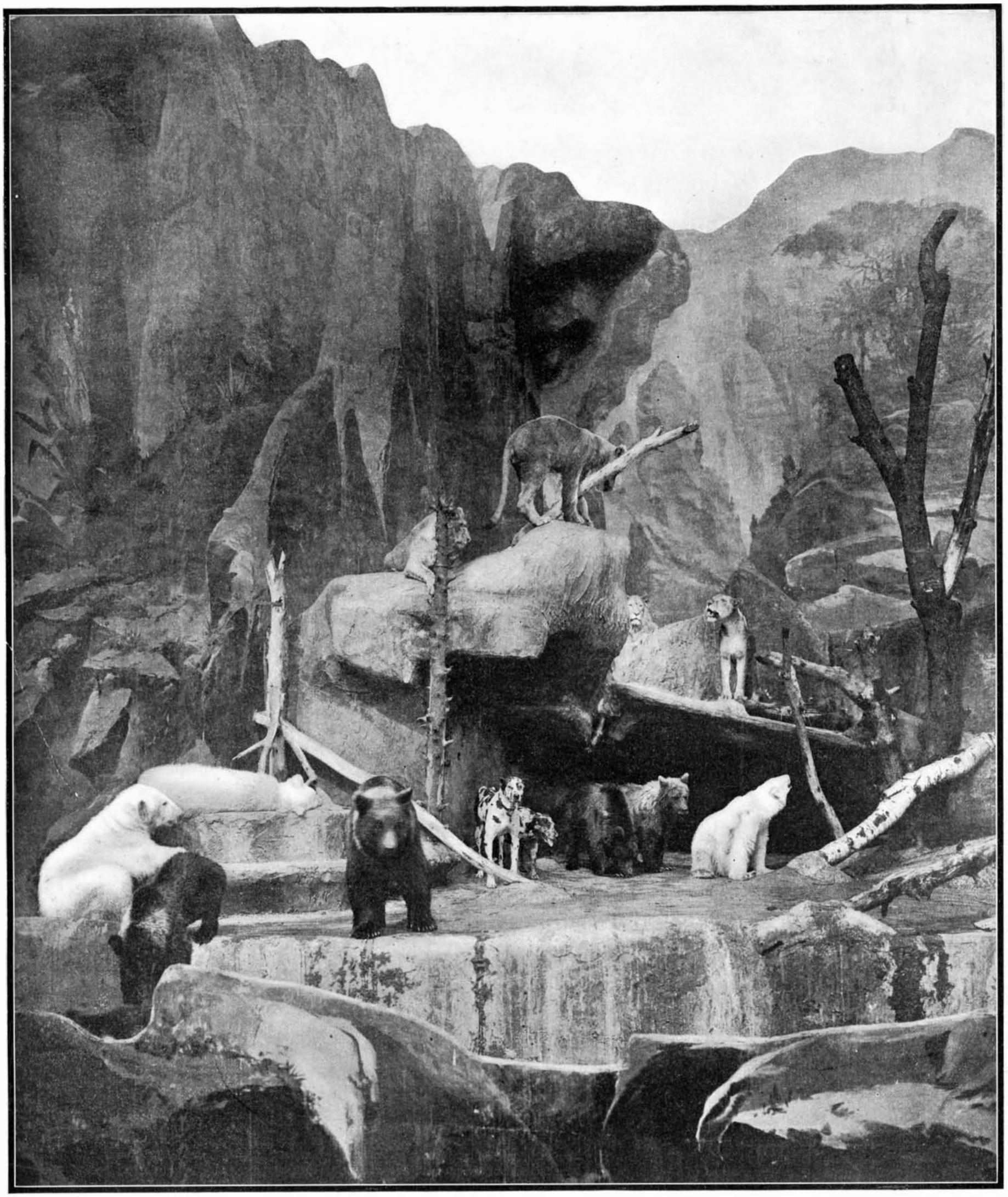

THE TRAINED ANIMALS AT THE WORLD'S FAIR.—[See page 97.]

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NEW YORK, SATURDAY, AUGUST 6, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE EXPOSITION AS AN EDUCATIONAL FORCE.

A great modern World's Exposition, like that of St. Louis, is intended first and last as a condensed exhibit, in concrete form, of the accumulated knowledge and practical achievements of the civilized world. The endeavor is made to gather this material together in such orderly arrangement and within such practicable limits of space, that the individual may turn to any part of it, and secure the information which he is seeking, with as much certainty as when he takes down an encyclopedia from his library shelves. To attempt the collection and arrangement of such an encyclopedia is a stupendous task in itself, and the writer ventures to assert, after many weeks careful study of the St. Louis Fair, that never, considering the magnitude of the undertaking, has so much material been gathered in one place and classified on an orderly and carefully considered plan, with such signal success as this. We have already spoken in terms of praise of the splendid architectural achievements of the Fair; and in the present connection, when dealing with its educational aspects, acknowledgment is due of the excellent manner in which the Director of Exhibits has brought to bear his experience in classification, gained in other great exhibitions of this character.

To anyone who watches critically the crowds that wander through the plazas and broad aisles of the exhibition palaces, what time they are not taking in the sights and sounds of that great highway of amusement, the "Pike," it would seem, at first sight, that the great bulk of the World's Fair visitors are drawn hither by the mere desire for amusement; but on a more careful study of the multitudes, and after taking note of the general run of comment and conversation, the conviction grows that the majority of the American people—there seem to be few foreigners at present within the Fair grounds—have come to St. Louis primarily to be instructed. The most positive proof of this is found in the crowded attendance at the various exhibitions of highly technical and scientific apparatus and phenomena, that are given in several different places throughout the grounds. Moreover, it is a significant fact that it is the more difficult and intricate exhibits, those that require intelligent thought and consideration if they are to be understood, that seem to present the strongest attraction to the sightseers. This is as it should be; and it may surely be taken as evidence that the main object for which the Fair has been conceived and carried out, namely, that of acting as a powerful educational force, is being abundantly fulfilled.

Undoubtedly these great expositions exercise upon the average citizen a broadening influence, which in a certain degree gives him a touch of that cosmopolitan breadth of view, which is commonly supposed to come only by actual travel. This would not be possible were the Fair conceived upon a smaller scale, and its exhibits spread out with a less lavish hand. A three-ring circus or a Wild West show may afford the untraveled citizen a glimpse of the outside world: but it takes a two-million dollar Philippine government exhibit, or the splendid gathering of distinct tribes under the Anthropological Department, to say nothing of the costly representation of foreign life and habits shown in private exhibitions—it takes the aggregate effect of all these to give to the visitor to a World's Fair that sense of having been actually in touch with the great outside world which is being realized by millions of visitors to the present Exposition.

The same broadening educational influence must be making itself strongly felt upon those who are making an earnest study of the carefully-arranged exhibits in the various exhibition palaces. There is a sense in which the inhabitants of a country so vast as our own, because of the lack of any means of direct comparison of themselves and their surroundings with some outside standard, may grow to a certain self-sufficiency, for which a study of the elaborate exhibits of other nations, and a knowledge of how greatly they exceed us in certain lines of achievement, will prove to be an admirable antidote.

Furthermore, an aggregation of such fine architectural and landscape effects as is presented at such an Exposition as this, must exert a lasting artistic impression, unconscious perhaps to the subject of it, but none the less real. It instills in the thousands and millions that throng the grounds new and lofty impressions of the grand and the beautiful. To many of the visitors these impressions will be capable of subsequent expression, and will no doubt show themselves in the improvement of public structures, in a more intelligent appreciation of what can be done in improving the artistic effects of buildings whether for the home, the city, the state, or the nation. This educative effect will make itself felt at many a city council where the inspection of competitive plans for municipal or other buildings come to be passed upon. We do not say that the World's Fair will make an art critic or a connoisseur of every citizen that visits it; but it will most certainly carry forward that national education, in domestic and municipal art and architecture, which owes its birth in this country largely to the great Exposition held at Chicago eleven years ago.

OSMON, A NEW COMBUSTIBLE FROM PEAT.

A new form of combustible, known as "osmon," has been lately produced in Europe from raw peat. Of the 90 per cent water which the peat contains, from 20 to 25 per cent is eliminated by an electric process. A direct current is passed through the mass of the peat, contained in a suitable tank. Under the action of the current, the water collects at the negative pole and flows out by openings in the side of the vessel. In carrying out the process, the inventors use from 10 to 12 kilowatt-hours per cubic yard of raw material. The process lasts about an hour and a half. The electrically-treated peat is then dried in the ordinary way and reduced to small pieces in a crusher. It is delivered to the trade in the form of balls or briquettes. The heating power of the new product is considerable. No trace of sulphur is found, and it does not smoke or leave much cinder.

M. CURIE'S EXPERIMENTS WITH RADIUM EMANATIONS.

In a paper recently read before the Académie des Sciences, M. Curie brings out some of the physiological effects of radium. The emanation given off by radium causes the death of the smaller animals, when breathed by them. He used an apparatus in which the animal is placed in a confined space and is made to breathe air which is charged with the emanation. A large jar is filled to one-third with pumice-stone soaked with potash. Above this is a support which confines the animal (a guinea-pig) in the upper part of the jar. Oxygen is introduced into the jar to keep up the animal's respiration, while the carbon dioxide which he gives off is absorbed by the potash. The radium emanation is sent into the jar by another tube at the beginning of the experiment. At the end of a certain time, varying from one hour to several hours, the respiration of the animal becomes short and abrupt; he rolls himself up in a ball with his hair standing on end. Then he falls into a profound torpor and his body becomes cold. Before the animal finally succumbs, his respiration has fallen as low as six per minute. The effects of ozone are eliminated in this case, as it is transformed to oxygen by the potash.

An examination of the animal showed an intense pulmonary congestion. The composition of the blood was modified, especially as regards the white corpuscles, and their number is diminished. The tissues of the animal are found to be radio-active. When the body of the guinea-pig is placed on a photographic plate wrapped in black paper, it gives an image in which the hairs are very clearly defined. All the different tissues have a photographic action. The hair shows the greatest effect, and the skin but little. The heart, liver, and brain possess this property, and especially the lungs. This action may be due to two causes, according to M. Curie; either the induced radio-activity of the tissues or the presence of the emanation dissolved in the humors of the body. In the above experiments he shows that radium has a toxic action not only when applied to the exterior of the body, as he already observed, but when it is introduced into the interior of the body by respiration.

TROPICAL SPECIALTIES FOR PORTO RICO.

Tropical Porto Rico is to be revolutionized. American influences there may not always have been for the best, but the process of adaptation is steadily progressing. When this is completed there will be a new future for Porto Rico. The prosperity of the island must always rest in its agriculture; but this must be brought up to date, and made to yield its quota of the world's goods that are in special demand.

Under the scientific directions of the Department of Agriculture it is proposed to make Porto Rico an island of specialties—specialties in tropical commercial fruits. Sugar, tobacco, and a few other staple products will not be abandoned; but the island's salvation appears to lie in other directions. It needs more variety of industries—more materials out of which to weave a solid, substantial prosperity.

The soil, climate, and other conditions are all there, and even the products, in some instances, but there have been lacking the brains and the ability to adapt nature to the demands of the day. For some time now government experts have been studying the botany of the island, and incidentally experimenting with some of the native and imported plants of commercial value. The opening of the new prosperity of Porto Rico will begin with the cultivation of these plants according to the most recent scientific methods. Many of them are indigenous to the island, but either through lack of proper culture, or ignorance of their commercial value, they have been of little real use to the natives. Others are to be imported from the Orient and transplanted to the island for cultivation. They are eminently adapted to the soil and climate of Porto Rico, and hence there is little doubt, in the minds of the scientists having the matter in charge, about their success.

One of these new plants to be transplanted from southern China or British India is the litchi tree (*Litchi chinensis*), which is eminently adapted to a climate and soil such as furnished in Porto Rico. Specimens of these trees have been brought to this country and experimented with in the Washington greenhouses, and plantations of them are expected to be planted in Porto Rico by the government experts within the next year. A litchi orchard once started should prove a source of income for the owner for a lifetime. The fresh fruit has a delicious flavor, and dried the fruits resemble raisins in appearance. A few of these dried fruits are imported from the Orient every year, and they sell as high as fifty cents a quart. In the Far East, however, they are eaten chiefly in their fresh, acid condition. Enormous quantities are consumed, and they are considered by natives and visiting foreigners in southern China, British India, and the Malay Peninsula as most excellent fruits. The cultivation of plantations of these fruit trees in Porto Rico should open a market here for their products, and in a short time the industry should prove a most paying and satisfying one.

The sapodilla tree is one that visitors to Florida see at times, but it has never been raised on a commercial scale in that State. The sapodillas are fruits that are greatly enjoyed in tropical countries, and there is a growing demand for them in our northern markets as they are better appreciated. The question of raising these in Porto Rico on a large commercial scale is not a doubtful or visionary one. It is believed that there is a great future for the trees when they are raised in sufficient quantities to make it worth while to introduce the fruits in our cities. These fruits could be brought by steamers direct to this country, and if properly refrigerated in transportation they would offer a tempting fruit to the millions of consumers in the United States. In Porto Rico there is no frost to endanger the life and production of the trees, and a plantation should continue to produce for upward of twenty years. When too old to yield a good crop, the trees furnish a most excellent and costly, close-grained wood that sells for nearly as much as the cost of starting and cultivating the grove for the first few years.

The tree which produces the cashew nut of commerce is a tropical growth that can be raised in Porto Rico on a large scale, and it is estimated that plantations of this tree alone should add many millions of dollars to the island's income within the next half century if its cultivation is wisely and faithfully attended to. The cashew nut is of superior flavor, and of great value in candy making. Its flavor is delicious, and the oil expressed from it is considered for many purposes superior to almond oil. The few cashew nuts brought from the West Indies to this country are readily absorbed, but their imports have been so small, and the prices so high, that they have never received the popular attention they deserve.

From the juice of the cashew tree many commercial products are made, such as mucilage, chewing gum, and various lotions and anæsthetics. The use of the products of the tree is so varied that it would require a good deal of descriptive text to explain them. The wood of the trees is excellent for commercial purposes, and has a close, compact, unyielding grain. Plantations of these trees should represent an agricultural specialty proof against nearly every kind of local disaster, except possibly hurricanes.

A tree known as *Cedrela odorata*, but commonly spoken of in tropical countries where it grows as ylang-ylang, thrives wonderfully well in Porto Rico. It is known in that island as the West Indian cedar, and its wood is more compact and beautiful than the best Central American mahogany. From different parts of Porto Rico this tree has been foolishly cut down and wastefully used for cabinet work and house-building. The flowers of this tree are beautiful and fragrant. From them is extracted a commercial product almost equal to the famous attar of roses. This attar of ylang-ylang is what makes the trees most valuable. It sells as high as five dollars per

pound. Ylang-ylang oil has been held almost as an exclusive monopoly by France and Germany; but a steady cultivation of the trees in Porto Rico should lead to a change. The oil is extracted by simple processes, and without the use of chemicals, and from seventy-five pounds of the flowers a pound of oil is usually produced. In Europe the oil of ylang-ylang is used as the basic essence of the best perfumes as much as the famous attar of roses.

GEORGE E. WALSH.

THE INFLUENCE OF MILKING UPON THE QUANTITY AND QUALITY OF MILK.

M. Lepoutre, agricultural engineer and assistant to M. Roquet, professor of zootechny and animal physiology at the Agricultural Institute of Belgium, has just made a series of interesting and careful experiments at the laboratory of zootechny and hygiene of the said institute for the purpose of determining the influence exerted by milking upon the quantity of milk, upon its composition, and particulary upon the proportion of its fatty materials.

Although our knowledge as to the influence exerted by the nervous system upon the physiological tissues is very meager, the experimenter started from the innervation (nervous stimulation) of the glands in general (to the greater or less excitation of which corresponds a more or less abundant secretion), in order to try to bring about an artificial excitation of the mammary innervation for the purpose of improving the lacteal secretion.

Broadly considered, the operation of milking is a rational massage that has the effect of drawing from the udder a quantity of milk much greater than that which is contained at the outset. It is admitted that the udder of a good cow may, before the operation, contain 3 quarts of milk already formed, while, if the animal is well treated, the udder may yield from 10 to 15 parts. It follows, besides, from the experiments of M. Lepoutre, that milking exerts a great influence upon the proportion of the fatty materials contained in the fluid. This influence is due, according to the experimenter, to the peripheric excitation of the nerves of secretion, which in their turn, by reflex action, bring about a greater excitation of the glandular cells. If we consider the general case of milking from two teats at once, as usual, we find that the effect produced is not the same during the entire period of the milking. The milk extracted from the first two teats is generally richer in fat than that of the two milked in the last place, and this richness will be greater if we simultaneously milk the two teats of one side, than if we simultaneously milk one teat of one side and one of the other, and then the two remaining ones—in other words, if we do the milking diagonally instead of laterally. The phenomenon is singular, if not obscure. It seems, however, explainable by the fact that in diagonal milking the excitation extends to all of the nerves of the gland, while in lateral milking it extends only to the side on which the operation is performed, and is consequently stronger. At all events, the influence of milking upon the proportion of fat is shown by the following experiment of M. Lepoutre. The same cow was milked several times and simultaneously by two different persons, who at each operation changed sides. The milk of each side was collected separately. One of the persons performed the operation by exerting a simple alternating pressure upon the teat, while the other performed a downward massage at the same time. The milk collected by the latter person was always markedly richer in fatty matter than that collected by the former. The difference was considerable, since in the first case there was 55 per cent of the total yield, and in the second 45 per cent. The method of milking has therefore a great influence upon the quality of the milk, and this influence is not explainable unless we grant that it bears some relation to the excitation produced.

On the other hand, the milk obtained at the beginning of the operation is not so rich as that obtained at the end. Up to the present, this fact has been explained by the statement that a prolonged operation ends by detaching from the lactiferous vessels the particles of butter adhering to the walls. M. Lepoutre is not of this opinion, and remarks that the operation is performed more vigorously at the end than at the beginning. The excitation must therefore be stronger, and the reflex action be greater upon the mammalary tissues, thus causing a lactiferous secretion richer in fat.

The experiments of Prof. Roquet's assistant tend to condemn all milking machines, especially those based upon the use of a centrifugal pump. Up to the present it has been thought that the superiority of hand milking is shown only by the quantity of milk obtained; but now it is necessary to add the superiority from the viewpoint of richness in fatty matters.

Although these facts would show machines to be useless which, it was thought, would some day solve the problem of mechanical milking, it is probable that more highly improved ones will eventually take their place. The principles upon which these new apparatus will be based will be those of the mechanical and intensive production of nervous excitation at present effected, unconsciously as it were, by manual treatment. It is not unlikely even, and it is the logical consequence of what has just been said, that the milking machine of the future, based upon such principles, will be able to perform the operation of milking better and obtain a greater quantity of milk, richer in fatty matters, in a more uniform and more scientific manner.

PHOSPHORESCENT CRYSTALLIZATION OF ARSENIOUS ACID.

BY A. C. MAURY.

In the crystallization of arsenious acid there is frequently displayed one of the most beautiful and interesting phenomena of physics, the emission of light by a crystal at the moment of its formation. The experiment is one of the most impressive in laboratory or lecture room, yet it is rarely attempted, owing to uncertainty of success. It was accordingly proposed in a previous article of the SCIENTIFIC AMERICAN, entitled "Light in Crystals," that a brief description should be given of the writer's method of preparing the phosphorescent solution.

Fresh samples of arsenious acid were dissolved in hydrochloric acid, the lumps being first ground to powder, and then boiled with the hydrochloric acid in a test-tube or small flask. Success is dependent mainly on the solution's being of the right strength, and the best results are obtained when 3.81 grammes of arsenious acid are dissolved in 4 cubic centimeters of hydrochloric acid at 18 per cent to 18.5 per cent. The liquid must be boiled till clear and free from undissolved material, but solution should be effected as rapidly as possible, since long boiling alters the strength of the hydrochloric acid. The most highly phosphorescent solutions are those made in five minutes. This point is found to be of less importance when a return-flow condenser is used, though even then solutions made rapidly are the most successful. The condenser is convenient, but the open tube or flask serves equally well, if the exact amount of arsenious acid is placed in it and quickly dissolved. A favorable condition is indicated by the bubbles' breaking tardily, as though the fluid were slightly viscous. A drop taken out on a glass rod and placed on a cold glass surface should at once form a white ring round the edge, and in a few seconds should turn all to white crystals. If the whole drop turns instantly to a white mass, the solution is too highly supersaturated, and the crystals will be thrown down before cooling and without apparent phosphorescence.

When ready, the solution is placed in a hot sand bath, and set aside in a perfectly dark closet, where it may cool slowly without being jarred by passing footsteps.

When still warm but no longer hot, it begins to show occasional sparks, which resemble the soft flashes of the phosphorescent light seen sometimes in the wake of a vessel on summer evenings. Frequently two or three crystals form at once, and their light is then prettily reflected against the glass. When the flask is shaken hard the illumination is very beautiful, resembling a fine display of the light at sea. The phosphorescence is visible on repeated shaking, the solution being allowed intervals of rest; or if the flask be left undisturbed, the tiny crystals form spontaneously, and sparks continue until or even after the liquid is quite cold. Crystals which dry on the sides of the flask are phosphorescent when scratched with a glass rod.

The slight sound said by some observers to be emitted by the crystals in forming has not been noticed.

Bandrowski in his experiments (American Journal of Science, January, 1896, p. 51) found the most favorable strength of the hydrochloric acid to be 16.5 per cent to 18 per cent, which is somewhat lower than that given above. In the experiments made by the writer, solutions at 18 per cent and 18.6 per cent were alone successful; those at 17.4 per cent, 19 per cent, and 19.7 per cent showed only a few faint sparks on hard shaking.

The difference in Bandrowski's results is doubtless due to the fact that with the lower percentage of hydrochloric acid he used a smaller amount of arsenious acid, viz., 15 grammes in 150 cubic centimeters of the dilute acid, for altering the strength of the hydrochloric acid alters the solubility of the arsenious acid; and as phosphorescence in all probability depends on the readiness of the crystals to separate from the fluid, it is likely that various corresponding proportions may meet the required conditions.

It is likewise owing to alteration in solubility that long boiling impairs the liquid. Loss by boiling alters the strength of the hydrochloric acid, and increases the solubility of the arsenious acid. Thus when the return-flow condenser is used, it is not found possible to dissolve more than 4 grammes of arsenious acid in 4 cubic centimeters of hydrochloric acid at 18 to 18.5 per cent; but when the liquid is allowed to boil away in the open tube while being kept replenished with fresh hydrochloric acid, as much as 6 grammes of arsenious acid are dissolved. In the latter case nearly half the liquid boils away and must be renewed. That boiling had no immediate effect on phosphorescence is shown by the fact that the first successful experiment is made by boiling a solution of unknown strength for a number of hours, when a beautiful display is seen.

In the above experiments the transparent or vitreous form of arsenious acid was used, some very fine samples from their laboratories in Germany having been kindly presented to the writer by Messrs. Merck & Co. It will be remembered that arsenious acid assumes this form when it has been freshly sublimed at a high temperature, after which it passes slowly into the white, opaque, crystalline form, in which it is commonly found. Becquerel, in La Lumière, stated that the transparent form alone gives phosphorescent crystals; but Bandrowski later found both varieties to be phosphorescent. Trials were made in the present experiments, selecting the opaque portions of the specimens, and phosphorescence was obtained, though the transparent portions gave perhaps the finer results. The fact that both kinds phosphoresce is of interest, because the theory was formerly advanced that phosphorescence is due to the change from the transparent form, which is amorphous, to the opaque, which is crystalline. The explanation must therefore be sought elsewhere, in connection with similar phenomena shown in other cases of simple crystallization.

SCIENCE NOTES.

The Carnegie Institution at Washington has received from Prof. Pumpelly a preliminary report of the investigations which he is making under the auspices of the Institution on the ancient site of Anau, near Aschabad, in Russian Turkestan. He reports gratifying success, the expedition having explored over 136 feet of successive culture strata, containing at least four almost uninterrupted culture stages, extending apparently for thousands of years through the neolithic and bronze into the beginning of the iron age, and having correlated the stages of culture with important events in the physiographic history and with the introduction of irrigation.—N. Y. Evening Post.

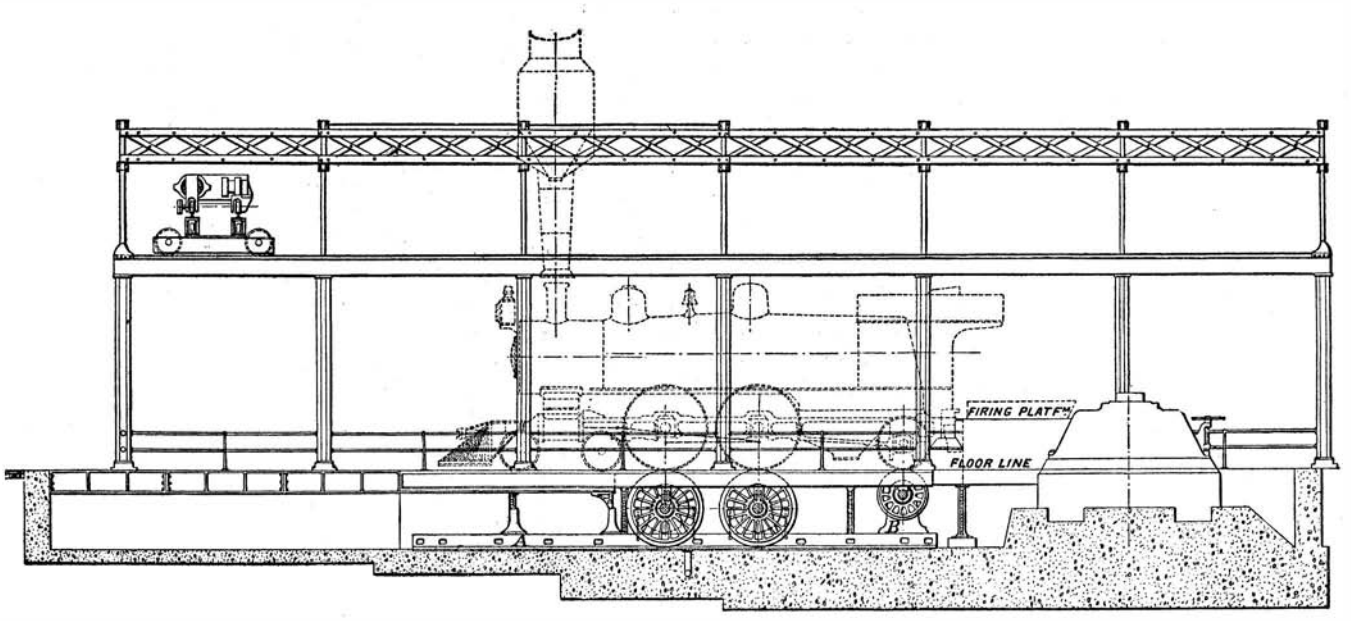
A series of interesting experiments with a new war kite for utilization with a newly-discovered system of wireless telegraphy were recently carried out with great secrecy before Kaiser Wilhelm. The inventor is a German-American professor, at present residing at Havre. The operations were carried out about a mile from the shore. No spectators whatever, beyond the naval officials and the Emperor and his suite, were allowed to witness the experiments. Seven kites were flown on copper wires to a height of from 10,000 to 12,000 feet. The experiments were partly made from the Kaiser's dispatch boat "Sleipner," traveling at the rate of thirty knots an hour, and several languages were employed. The feature of the invention is the possibility of transmission over the greatest distances without affecting any other wireless telegraphy station. The form of the kites used is that of two cubes side by side, similar to the Cody box kites.

From the bark of trees and shrubs the Japanese make scores of papers, which are far ahead of ours. The walls of the Japanese houses are wooden frames covered with thin paper, which keeps out the wind but lets in the light, and when one compares these paper-walled "doll houses" with the gloomy bamboo cabins of the inhabitants of the island of Java or the small-windowed huts of our forefathers, one realizes that, without glass and in a rainy climate, these ingenious people have solved in a remarkable way the problem of lighting their dwellings and, at least in a measure, of keeping out the cold. Their oiled papers are astonishingly cheap and durable. As a cover for his load of tea when a rainstorm overtakes him, the Japanese farmer spreads over it a tough, pliable cover of oiled paper, which is almost as impervious as tarpaulin and as light as gossamer. He has doubtless carried this cover for years, neatly packed away somewhere about his cart. The "rikisha" coolies in the large cities wear rain mantles of this oiled paper, which cost less than 18 cents and last for a year or more with constant use. An oiled tissue paper, which is as tough as writing paper, can be had at the stationer's for wrapping up delicate articles. Grain and meal sacks are almost always made of bark paper in Japan, for it is not easily penetrated by weevils and other insects. But perhaps the most remarkable of all the papers which find a common use in the Japanese household are the leather papers of which the tobacco pouches and pipe cases are made. They are almost as tough as French kid, so translucent that one can nearly see through them, and as pliable and soft as calfskin. The material of which they are made is as thick as cardboard, but as flexible as kid.—David G. Fairchild in the National Geographic Magazine.

THE LOCOMOTIVE-TESTING PLANT AT THE WORLD'S FAIR.

THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Perhaps the exhibit which is attracting more attention than any other in the Transportation Building is the elaborate locomotive-testing plant, which is under operation by the Pennsylvania Railroad. It is a remarkably complete installation, and the tests are being carried out upon a scale and with a detail which has never been attempted before. Locomotive engineers, and indeed the whole world of steam engineering, are following these experiments very closely; for it is realized that when the twenty locomotives that are to be tried have passed through their ordeal, the steam engineering world will be in possession of an invaluable mass of carefully tabulated data, that must remain the standard reference upon this subject for many years to come.



THE LOCOMOTIVE-TESTING PLANT AT THE FAIR.

We present the general arrangement of the plant in the accompanying photograph. The locomotive under test is carried on supporting wheels, whose axles are extended laterally to receive the absorption or friction brakes. The locomotive is run at the desired speed, causing the supporting wheels which are beneath the floor to revolve, and the latter are retarded by the brakes to any extent desired. The work actually done by the locomotive consists in overcoming this frictional resistance, and the resulting force exerted at the drawbar is measured by a traction dynamometer.

There are two sets of supporting wheels, one consisting of three pairs, 72 inches in diameter, for use under passenger types of locomotives having large driving wheels, and one set of five pairs, 50 inches in diameter, to be used under locomotives with smaller wheels and designed for freight service. On the ends of each supporting shaft of the carrying wheels are the absorption brakes, which form the resistance that the locomotive must overcome, in order to exert its tractive effort at the drawbar. This brake consists of a smooth, revolvable, grooved cast-iron disk keyed to the shaft which transmits the power to be absorbed; a non-revolvable housing with bearings upon the hub of the revolvable disk; a pair of copper plates fastened to the housing, one face of each copper plate being close and parallel to the sides of the revolvable disk, the other face of each plate having back of it a chamber in the housing; a system of piping by which water under pressure can be circulated through the chambers between the copper plates and the housing; and a system of piping by which oil is circulated so as to insure perfect lubrication of the copper plates which are next to the revolvable cast-iron disk. The oil for lubrication between the revolving surfaces enters near the hub of the disks, is carried by centrifugal force along the radial grooves in their sides, and out to their peripheries.

When the brakes are in use, water under pressure flows through the chambers in the housings, pressing the copper plates against the sides of the revolving disks and causing resistance to their rotation. The pressure of the water is regulated by valves controlling both the inlet and outlet independently. To keep the speed of the locomotive constant there is a by-pass around the main valve controlling the supply of water for all the brakes, and in this by-pass is an automatic valve controlled by the speed of the locomotive. If the speed increases beyond the desired number of revolutions per minute, the by-pass valve opens, so as to increase the pressure on the brakes, and if, on the other hand, the speed of the locomotive falls below that desired, the automatic valve closes and decreases the pressure on the brakes.

A traveling electric crane of ten tons capacity, with a span of 43 feet, serves the entire space occupied by the testing plant; it is used for handling the supporting wheels, axles, etc., and for handling all the coal and heavy material used during the tests.

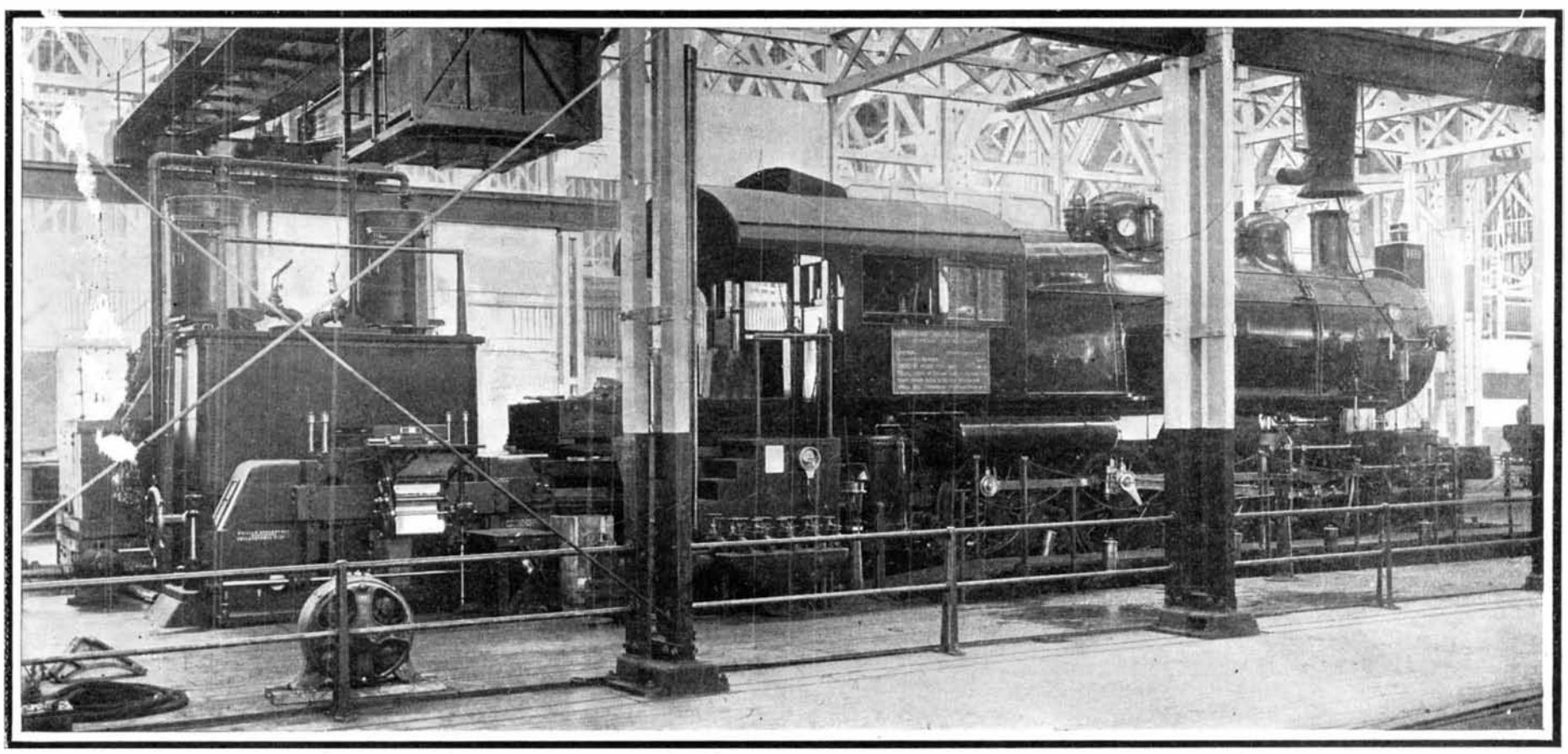
The water is weighed in two tanks, filled alternately, and run from these into a third tank, from which it is taken by piping to the injectors. The traction dynamometer is of the lever type, and is constructed on the "Emery" principle, in which flexible steel plates take the place of knife edges as used in ordinary scales. The drawbar is provided with a ball joint, to allow for any side motion of the locomotive, or motion of the locomotive on its springs. Near the base of the dynamometer the oscillating motion of the ends of certain levers in the dynamometer is transformed into rotary motion, and kept in constant tension by clamping devices. This is done by means of steel belts which are wrapped around a drum. This drum is mounted on a tube guided in ball bearings, and inside of it is a rod, the upper part of which is securely fastened to the tube, the lower end being firmly attached to the frame of the machine. When the belt is rotated, the rod inside of the tube is in torsion, and this resistance is constant for the same travel of the recording pen.

To the upper end of the tube above mentioned are secured two radial arms, the extreme ends of which are finished to a circle having its center at the center of the tube. The angular motion at the end of one arm imparts straight-line motion to a carriage which is guided by a grooved track, and carries the recording pen. The opposite arm is coupled by steel belts to a rotary oil dash-pot, to reduce violent oscillations of the recording pen. The principal resistances in the dynamometer are flat springs, placed under the second levers and deflected by the motion of these levers. There are three sets of these springs, varying in resistance, so that a travel of eight inches of the recording pen corresponds to a drawbar pull of either 80,000, 40,000, or 16,000 pounds, as may be desired. The drawbar pull is traced upon a strip of paper 18 inches wide, which is clearly seen in the illustration, the paper being made to travel at a known rate of speed for each mile run by the locomotive; and this will form the permanent record of the draw pull in each test.

The instruments necessary to get full information for the tests consist, in addition to the dynamometer, of steam engine indicators, steam pressure gages, draft gages for smoke box, fire box, and ash pan, thermometers for temperatures in the smoke box, calorimeters for getting the quality of steam, a revolution counter, and a tachometer for showing the speed in revolutions per minute.

The plant is in charge of a Director of Tests, and under him are an assistant and a foreman and a large staff of trained observers who take note of the coal and water used and who take indicator cards, temperatures and readings from all the instruments of the testing plant.

As the data is secured it is promptly tabulated, and the computations worked up by a large staff,



A FREIGHT ENGINE UNDERGOING A TEST AT THE LOCOMOTIVE-TESTING PLANT OF THE LOUISIANA PURCHASE EXPOSITION.

a total force of twenty-five men being constantly employed.

COUNTERWEIGHTED CABLE TRAMWAY.

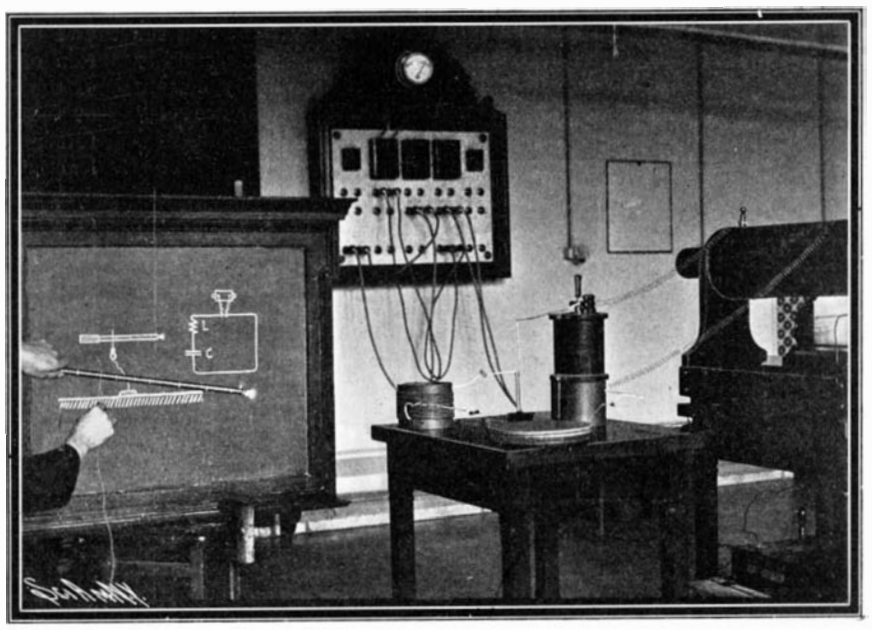
BY JOHN PLUMMER.

During the work of extending one of the Sydney suburban cable tramway lines to the shores of the harbor, considerable difficulties were encountered in consequence of a rapid drop of level near the terminal point, and several schemes were proposed, that had to be abandoned on account of the costly resumptions which would have to be effected in order to carry them out, the land on either side of the thoroughfare being covered with buildings. The idea of adopting a subterranean counterweight was suggested, and, after some consideration, a scheme was devised and worked out by the officers of the state department of public works. The scheme presents some features new in Australia. The extension was an extremely short one, being only nine chains in length, but the grade was 1 in 8.48. The permanent way on the street surface is constructed of 85-pound grooved rails, tied to a center slot over a tube of concrete similar to cable tramway constructions. Upon this track the cars run, being preceded by a buffer trolley, which has a gripper attached to a steel-wire rope, fixed at one end to a small counter-weight trolley, which is weighted to ten tons. This travels on rails laid on a 2-foot 6-inch gage in a subway parallel to the tramway track on the surface. The wire rope is led round a 6-foot horizontal sheave, at a point near where the drop in the level commences, from the cable tube to the subway, at the terminal end of which a hydraulic buffer, with a cylinder 10 inches in diameter, 3-foot 6-inch stroke, is fixed, provided with weights to draw out the buffer-rod after being compressed by the impact from the weighted trolley. The track is bonded and the overhead wire construction is carried out in the usual manner. The whole arrangement has proved in every way satisfactory in the working, not a single mishap having been reported.

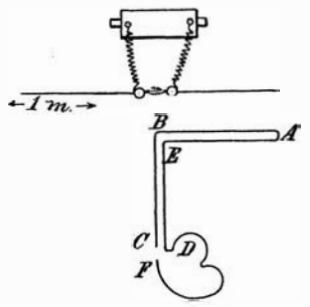
A NOVEL WAVE METER FOR WIRELESS TELEGRAPHY.

BY OUR BERLIN CORRESPONDENT.

On account of the forthcoming international regulation of space telegraphy, the question of a suitable apparatus for measuring the wave length of the sending apparatus is assuming the highest importance. The writer, a short time ago, had the good fortune of inspecting in the laboratory of Prof. Slaby, of the Charlottenburg Technical High School, the "multiplier rod" designed by this well-known experimenter for the above purpose. The principle underlying the apparatus, as acknowledged by Prof. Slaby, has been found independently of himself both by Nicola Tesla and Dr. Oudin, a French physician. While testing a linear vibrating system generating quarters of a wave length of one meter, which were received by a rectangular loop receiver (Fig. 1), Prof. Slaby obtained the same tension curves both for *A B C* and *A E D*, comprising nodes located in *B* and *E* and crests at *A* on one hand and *C* and *D* on the other, the tension in the two latter points being absolutely identical and of the same phase. Now, a phase difference amounting to 180 deg. (the tension remaining the same) was obtained between *D* and *C* by connecting *D* to a wire *D F*, two meters in length, so as to allow of half a wave being produced therein, which resulted in the tension between *F* and *C* increasing to values nearly twice as great as those previously obtained in *C* and *D*. Further increases were noted as Prof. Slaby, in order to give the additional wire a more convenient form, wound up the same in a coil; whenever to the tension maximum of an oscillating circuit, a wire $\lambda/2$ in length was connected, the terminal tension could be raised to multiple values in the case of the additional wire forming a coil. This is why such coils, tuned for the wave length of the system, were termed "tension multiplier." The experimenter also found that the increase in the terminal tension was attended by a distortion of the wave, previously quite regular, so that the beginning of the coil would form neither a perfect tension node nor a current node.



NOVEL WAVE METER FOR WIRELESS TELEGRAPHY.

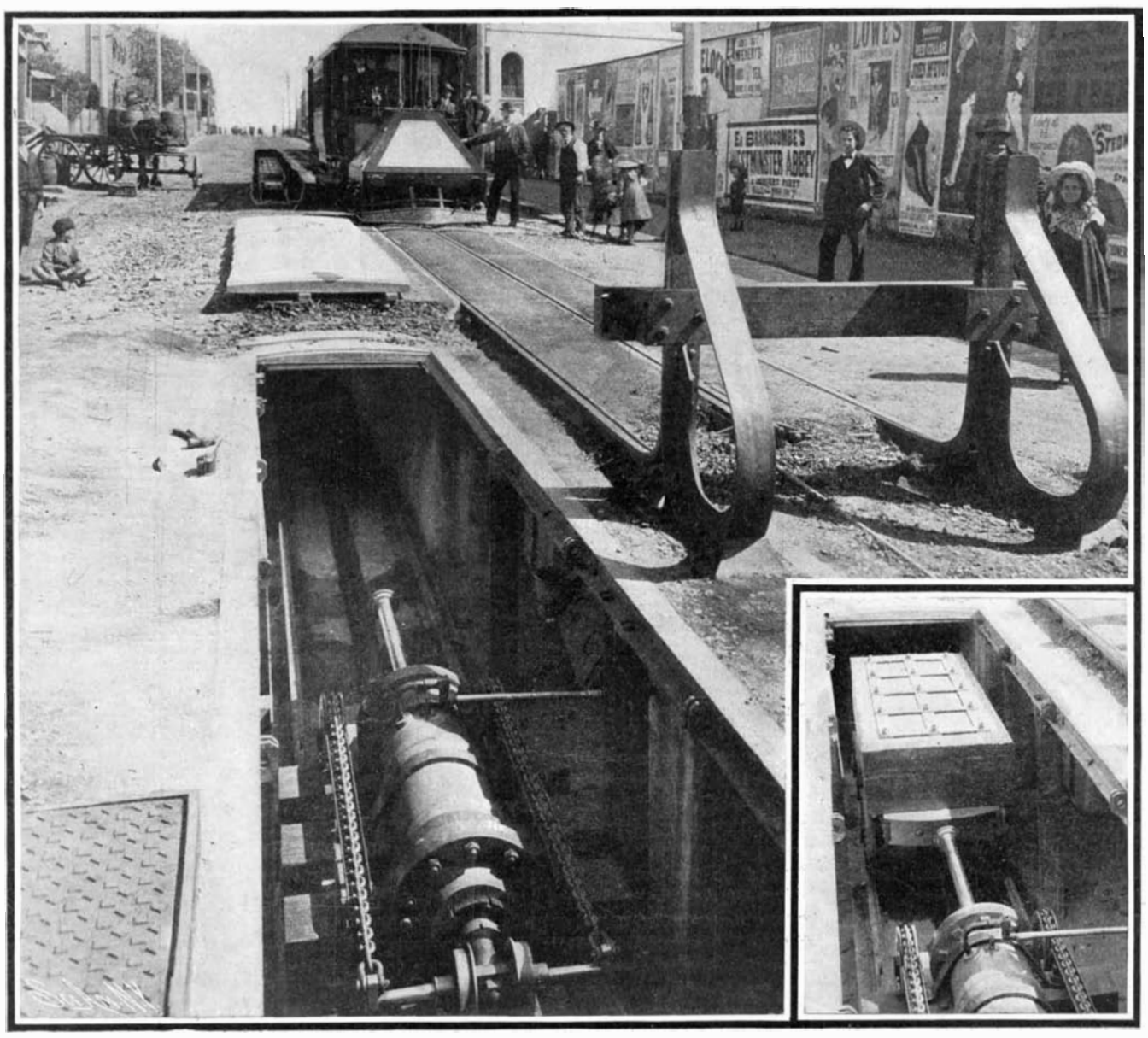


PRINCIPLE OF THE WAVE METER DIAGRAMMATICALLY SHOWN.

Prof. Slaby gives a rather simple theoretical explanation of this phenomenon, showing that any earthed wire systems, receiving an electric pulse of a certain frequency, will vibrate in resonance in case what we terms their vibration capacity (the product $C L$ of the electrostatic capacity by the self-induction) is the same, so that the equation $T = 2\pi\sqrt{C L}$ is satisfied. Now, the electrostatic capacity may be varied somewhat, without the above equation ceasing to be satisfied; the energy of the oscillating system, however, which depends on the electrostatic capacity, will be altered in proportion. It is shown that a system of n parallel wires, placed at mutual distances as high as possible, will have a self-induction as small and an electrostatic capacity, and accordingly vibration energy, as high as possible. Such oscillating systems are therefore most suitable for transmitting electromagnetic energy for space telegraph purposes; the surface tension at the ends of the wire cannot in fact increase beyond admissible limits, so as to produce a radiation of electric masses (electrons), which would mean a noticeable loss of energy.

Now, the reverse would be true in the case of a visible mark being required in the circuit to indicate whether the dimensions of the latter correspond to the maximum energy input, that is, whether the circuit is tuned for the frequency of the oscillation transmitted to the same. As in the latter case a radiation of electrons as strong as possible should be aimed at, the vibration capacity should be chosen so as to insure a surface tension as high as possible by combining a minimum electrostatic capacity with a maximum magnetic capacity or self-induction. This is obtained by designing the vibrating conductor as a coil. Prof. Slaby shows by simple theoretical considerations that the electron radiation of such multipliers is in the first place dependent on the pitch of the coil. Wires of a diameter as small as possible, coated within an insulating material as thin as possible, should therefore be used in this connection. Copper wires 0.1 millimeter in thickness, comprising a single silk winding or else an extremely thin insulating coating of cellulose acetate, gave quite satisfactory results. This copper wire was wound on glass tube and on ebonite and oak rods of different diameters, and the resonance length of the rods in the case of a unipolar earthing, ascertained for a given wavelength. Slaby gives an approximate relation between the capacity, self-induction, and own vibration of a coil, from which the wave length may be calculated with an accuracy of some tenths of one per cent.

Now, in regard to the question as to how the vibration energy from the circuit tested may be transmitted to the multiplier rod, so as to have the latter still vibrate in a quarter of a wave length, a direct connection would result in the wave undergoing a distortion (see above), the connecting point not being a node. This drawback was first obviated by establishing a monopolar connection between two



The Buffer Trolley descending. The Trolley ascending.

AUSTRALIAN COUNTERWEIGHTED TRAMWAY.

identical multiplier rods, and causing them to vibrate in one-half of a wave length, so as to give rise to the spontaneous formation of a node in the connecting wire. Such instruments (termed "tuning fork" multipliers) comprising two parallel coils placed beside one another in a box and adjusted by a slide contact bridge (short-circuiting the lower winding, until the upper end began sparking, the rectilinear connecting wire absorbing the vibrations magnetically) gave quite satisfactory results. Now, continuing his experiments, Prof. Slaby observed that the whole room was strongly ionized as soon as an oscillating circuit was set working. A monopolar earthing was readily made in his laboratory, the floor of which is laid throughout with zinc plates, thus constituting an artificial earth of sufficient capacity (9,000 centimeters); the capacity of the human body, being about 100 centimeters, proved perfectly sufficient to impart to the multiplier the potential zero when touching its end. When keeping in the left hand a multiplier rod provided at one end with a metallic ring touching the latter, and carrying the thumb and index of the right hand alongside the rod, the free end of the latter would begin sparking as the index reached the resonance position, the more strongly as this end was turned toward the oscillating circuit; a more accurate adjustment may be obtained by carrying over the multiplier rod a short metallic rod, grounded by means of a wire which was fixed to a metallic plate lying on the ground. The best results were obtained by causing the violent radiation from the sparks to act on fluorescent bodies. When placing crystals of barium platino-cyanide in the end of the rod, an extraordinary intensity of the luminous effect was noted, so as to obtain a light-green spot, noticeable even in direct sunlight. When intermixing gold leaf with small leaves covered with the above crystals, a bright green luminous torch was noted, as an evidence of the multiplier rod being tuned.

In order to ascertain the accuracy warranted by the multiplier rod in this definite form, the inventor caused the same wave length to be measured by two different observers at different times, which difference in the case of a single adjustment was very seldom upward of 1 per cent, being in most cases below 0.4 per cent and 0.7 per cent, whereas in the case of a tenfold adjustment the average value of any two observers never differed by more than 2.5 per cent.

When considering that the determination of wave length according to previous methods required a whole series of observations, extending at least over half a day, the multiplying rod, allowing of the tuning of wireless telegraphy stations being checked almost instantaneously and in a way as accurate as possible, may be said to embody a most valuable advance, likely to materially further the development of wireless telegraphy.

Clay-Working Industries of the United States.

A chart showing in tabular form the quantity and value of the clay products of the United States in 1902 as distributed throughout the several States was published by the United States Geological Survey late in 1903. That is now supplemented by the publication of a report entitled "Statistics of the Clay-Working Industries in the United States in 1902." The author of both chart and report is Mr. Jefferson Middleton, who did the work under the supervision of Dr. David T. Day, chief of the Division of Mining and Mineral Resources.

The year 1902 was one of prosperity in the clay-working industries, the product reported increasing from $110,211,587 in 1901 to $122,169,531 in 1902, a gain of $11,957,944, or 10.85 per cent. It is significant, however, that the firms reporting in 1902 numbered but 6,045, as against 6,421 in 1901, the figures showing a decrease of 376, or 5.86 per cent. This decrease can be accounted for only by the fact that many individual firms have combined and reported as one plant, as no plants of importance that reported in 1901, except one in Texas, are delinquent in 1902. This is further shown by the fact that the average value of the output per plant increased from $17,164 in 1901 to $20,210 in 1902. A remarkable advance in the cost of labor and of building materials began in 1900, and although it does not seem to have had a serious effect on the clay-working industries during 1902, it is probable that it prevented the value of the clay product from rising above $126,000,000 in 1902, as it normally would have done.

The great coal strike of 1902 would seem to have had little direct effect on the brick and tile industry, although the pottery industry in the Eastern States, where considerable anthracite coal is used, may have suffered to some extent from the strike. The increased cost of fuel which followed the strike will undoubtedly make itself felt in the brick and tile industry in increased cost to the consumer.

One of the most significant features of the year was the successful installation of several plants for the manufacture of sand-lime brick. At the close of the year three or four plants of this character were in operation in different sections of the country, with the prospect of a large increase in their number in the near future. There seems to be no doubt that the manufacture of this class of brick will be successfully carried on in many localities. It is equally certain that sand-lime brick will not wholly displace clay brick.

A HANDLESS CLOCK.

In many a shop window of the more prominent avenues of the city of New York may be seen a novelty in the form of a clock that indicates the time, not by means of the traditional dial and hands, but simply by the exposure of numbers representing the hour and minute. If it is 21 minutes past 3, for example, the clock simply exhibits the number 3 above the number 21, and thus indicates the time in a simple and rational way. New as the idea of such a time-

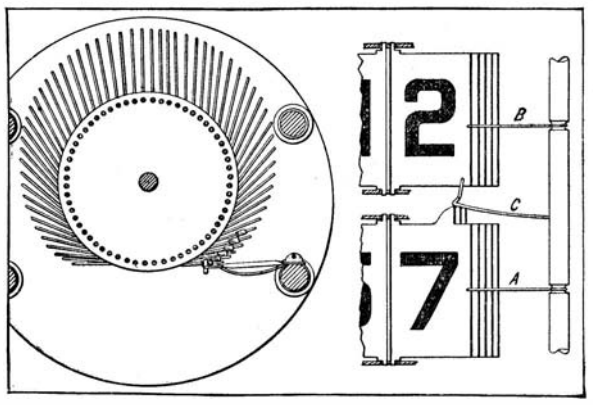


Diagram Showing the Method of Simultaneously Releasing the Hour and Minute Leaves of the Handless Clock at the End of an Hour.

piece may be to many, its underlying principle is not of recent conception. Handless clocks of some form have been known for many years, but the difficulties which have attended their manufacture have prevented their commercial introduction.

In the clock to which we have referred, these hindrances seem to have been successfully overcome by its inventor, Mr. Eugene Fitch, if one may judge by the popularity of his timepiece. The makers of the clock, the American Electrical Novelty and Manufacturing Company, of 314 Hudson Street, New York city, have carried out the inventor's principles in a manner that is well worth some brief description.

A HANDLESS CLOCK.

Broadly speaking, the handless clock consists of two series of indicating leaves freely pivoted to form drums held between rotating disks. The upper drum of leaves indicates the hour, the lower drum the minute. A clock train drives the two drums in such a manner that the leaves of the minute drum flip past as each minute passes, while the hour drum still indicates the hour. At the end of the 59th minute of the hour, it becomes necessary to effect a simultaneous movement of the hour and minute drums, in order to indicate the even hour. It is the attainment of this end which has presented so much difficulty to inventors, and which has been overcome in this invention.

Mr. Fitch has effected this simultaneous change of indication by controlling the movement of the leaves of one set, the hour leaves for example, by leaves of the other (the minute leaves), so that one or more minute leaves will control each hour leaf in advance of and until the proper time for the change of indication of the hour leaf. Thus the change of indication of the hour leaf is prevented until the proper change of indication of the minute leaves has occurred. In this manner a variation in the accuracy of the hour leaf is obviated.

Referring to the accompanying diagram, two sets of spring stops are employed, the one, *B*, to hold back the hour leaves, the other, *A*, the minute leaves, for the proper interval. The control of the hour leaves by the minute leaves is effected through an additional stop, *C*, for the hour leaves, controllers in the form of projections being provided on six of the minute leaves to regulate the movement of the additional stop, *C*, so as to cause it to hold an hour leaf from the engagement of the first controller with the additional stop, until the last minute leaf carrying a controller has been released. The first minute leaf carrying a controller is that which indicates the 54th minute of the hour, and the last minute leaf carrying a controller is therefore the minute leaf which is held for the indication of the 59th minute. Should the hour leaf stop, *B*, release the hour leaf at any time during this interval of six minutes, the hour leaf will still be held by the additional stop, *C*, until the minute leaves change the indication from 59 minutes to the even hour. In this manner ample provision is made for the ordinary variations in the release of the hour leaves by the hour leaf stop, *B*. In the clock shown in the illustration there are sixty hour leaves, five for each hour. The hour leaves are changed at intervals of twelve minutes (exhibiting, of course, still the same figure), and during this interval twelve minute-leaves are changed.

Destruction of the Cork Forests of Italy.

The cork industry, which is quite an important one, will receive a fresh impetus, a new process having been discovered by which large pieces can be made out of small ones, so that cork waste can be utilized in large quantities. This is all the more important as the price of cork increases steadily, both on account of the growing demand and the lessened supply of the raw material.

Formerly Italy was a large producer of cork, but a great part of her splendid cork-oak forests has already been destroyed. In some provinces—as, for instance, in Calabria—the trees have been felled and used for charcoal making; in other provinces they have been cut down on account of their high potash contents.

Larger forests of cork-oak trees are still existing in Spain, Portugal, France, Algeria, and Tunis. None are found in Asia Minor and only rarely in Greece and European Turkey, although the climates seem to be favorable for their growth. The area covered by these forests is estimated at 300,000 hectares (741,300 acres) in Portugal, 250,000 hectares (617,750 acres) in Spain, 280,000 hectares (691,880 acres) in Algeria, and only 80,000 hectares (197,750 acres) remain in Italy.

While Spain still furnishes 32,800 tons of cork annually, the production of Italy has decreased to 4,000 tons. The value of the Spanish exports of cork amounts to $6,000,000 per year, against less than $250,000 for Italy. Only Sicily and Sardinia are still producing cork to any considerable extent in Italy, while the former great oak forests of Calabria are almost totally destroyed. It seems incomprehensible that this destruction has been permitted. The trees easily reach an age of 200 years. They yield cork in their thirtieth year and continue to do so every seven years. Seventy-five years ago the English demand for cork was supplied exclusively from Italy. The destruction of the remaining forests goes on uninterruptedly, and nobody seems to try to prevent it or to plant new forests in spite of the fact that Italy possesses the most favorable climate and soil for the cork oak, the most favorable conditions for its growth being found in the volcanic soil of the peninsula.

The recent three-hundredth anniversary of the death of Gilbert, of Colchester, the founder of the science of electricity, was honored by the presentation, by the Institution of Electrical Engineers of Great Britain to the borough of Colchester, of a painting by Mr. A. Ackland Hunt, representing Dr. Gilbert showing his electrical experiments to Queen Elizabeth and her court. Gilbert discovered the augmentation of the power of a loadstone by arming or capping it with soft iron cheeks, the screening effect of a sheet of iron, the method of magnetizing iron by hammering it while it lies north and south, the destruction of magnetism by heat, and the existence around the magnet of a magnetic field. Generalizing from small to large, he advanced the entirely novel idea that the globe of the earth is itself a magnet. His book *De Magnete*, over which he spent eighteen years, was published in 1600, and for the next three hundred years remained the standard work on magnetism.

Correspondence.

Registration Balloons.

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of July 23, 1904, the article entitled "Registration Balloons in Italy," speaks of the use of these balloons for exploring the high atmosphere over Europe as a recent initiation. Although it is true that Italy has but lately co-operated, this work has been going on in France and Germany for several years. In the United States the Blue Hill Observatory alone has aided the investigation by kite flights made on a designated day every month, it being impossible, on account of proximity to the ocean, to employ balloons here.

Now, however, through the co-operation of the authorities of the St. Louis Exposition, an attempt will be made, under direction of the undersigned, to obtain the first data concerning the temperatures prevailing in the free air at great heights above the American continent. A. LAWRENCE ROTCH,

Director and American Member of the International Committee for Scientific Aeronautics.

Hyde Park, Mass., July 21, 1904.

Hay Fever.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with some interest in your valuable publication an occasional article on hay fever and hay asthma, its cause and effect; and now that the season for this most distressing malady is fast approaching, feel that a word relating thereto will not be amiss. Having suffered from this distressing ailment for the past eighteen or twenty years I feel at liberty to express my views on the subject without offering an apology to the medical profession.

The generally accepted hypothesis, or consensus of opinion among the medical profession, so far as I can learn, is that the pollen from grass and various weeds, dust, and atmospheric conditions are the *causes* of hay fever and hay asthma. This, to my mind, is an egregious error, and can, possibly, be best refuted by presenting the matter in a hypothetical form. As some patients have hay fever and no asthma, we will first take up the question of hay fever. In order to disprove the generally accepted theory, let us suppose, for instance, that a person cuts his finger on some sharp instrument, and after a time a little salt gets in the cut. Now, while it is true that the salt will cause the wound to smart, or hurt, it must be admitted that the salt is not responsible for the cut. The cut is due to another and entirely different cause; and the salt only tends to irritate, or act as an irritant. So it is with hay fever. The diseased condition is already established, and it only takes the pollen from the various weeds, or dust, to produce the effect.

Now let us take the hay asthma condition. It is generally believed that the same *causes* which are supposed to be responsible for hay fever are also responsible for the hay-asthma condition—pollen of grass and weeds, dust, and atmospheric conditions.

This theory, to my mind, is also wrong; and until such time as we get on the right track, as it were, the chances of successfully combating these diseases are *nil*. If the pollen from grass and various weeds, dust, and atmospheric conditions are the *causes* of hay asthma, then why does not every one suffer alike from it? The fact is that these things merely act as an irritant, and are not the *cause* of the disease at all. There can be no more cogent proof that this is true than the fact that all do not suffer from it alike. Let us take, for instance, an asthmatic when he is entirely free from the disease, and let him eat a hearty meal of solid food. We must admit that the food he eats goes to his stomach; but where is the effect? The effect is in the lungs, tubes, or air cells. This is merely cited to show that while the effect is in the lungs or pulmonary organs, we must look elsewhere for the cause. The first thing to do, therefore, is to ascertain the true cause or causes of the ailment, when no doubt a sanative or sanatory remedy can be found with which to combat the disease.

I hold the opinion that hay fever, bronchitis, and hay asthma all spring from a common cause—catarrh. In fact, they are merely the different stages of catarrh. When we succeed in curing catarrh in all its forms, we will at the same time cure hay fever, bronchitis, and hay asthma. Hay fever is due to a diseased condition of the membraneous lining of the nose and throat, caused by catarrh, and which causes the linings of the nose and throat to become susceptible to the pollen of grass and weeds, and from dust, which act, as above stated, as an irritant.

The hay asthma condition is due to an exuberant production of mucus or phlegm, which obstructs the lungs and air passages and is caused by a catarrhal condition. If, therefore, we stop the unnatural production of this mucus or phlegm, we at the same time remove the deep-seated cause of the disease, and the result is freedom from hay fever and hay asthma.

Sewickley, Pa., July 23, 1904. S. F. BARRATT.

Electrical Notes.

The telegraph line from Vienna to Czernowitz is the longest line in Europe which uses the duplex system, being 630 miles long. The system was adopted a few months ago, as it was found necessary to increase the capacity of the line, which takes all the matter for Roumania, Southeastern Russia, and a part of Bulgaria. On account of the increase of traffic, especially during the summer, it was at first proposed to double the line, but this would have cost $60,000, while the duplex system which was adopted cost scarcely $1,000 to install. The system works well at present, although the line is constructed of iron wire instead of copper.

At the Iowa Electrical Association a discussion arose on the Nernst lamp in practice. The verdict was generally favorable; the deficiencies noticed were generally such as arose from circumstances inherent to electric lighting systems generally, and tended to show that the lamp is at present not possessed of sufficiently strong constitution to resist great changes of temperature. But briefly, it all amounted to the fact—already well known, for that matter—that the Nernst lamp cannot withstand any great increase of voltage for any considerable period, and that very close regulation is necessary. It is said that a filament will stand about the same variation of voltage as 3.1 watt incandescent lamp, which looks well. On the other hand, another speaker said that the cost of maintenance was about one quarter cent per kilowatt hour supplied to the lamp, and this looks heavy. Another speaker said that his main difficulty had been in connection with the burning out of the heaters, since the customer did not switch off the lamp when the filament burnt out. But a very short experience on the part of the consumer will rectify this, and it is satisfactory to be able to report that the lamp is making headway in the United States.

Prof. K. Birkeland has, according to the Elektroteknish Tidsskrift, Christiania, taken out patents for a process for obtaining electric arcs of very large surface. The invention is based on the production of a chemical compound or a decomposition of gas mixtures or gases by means of a special kind of electric arc. Electric arcs will exert chemical effects on gases, this effect being essentially dependent on the magnitude of the contact surface between the arc and gas mass. In order to augment this contact surface, the use of electrodes has been suggested, of such an arrangement and moving with respect to each other so as to expand the arc longitudinally, until the distance between the electrodes becomes too great. With this method exceedingly small currents were necessary. The process suggested by Birkeland consists in placing the point of contact between two conductors, one or both of which are susceptible of a vibrating movement, traversed by an electric current in a strong magnetic field. The inventor has found that under these circumstances an electric arc is formed between the contact points, even when the distance between the latter is increased only to a fraction of a millimeter, to be thrown violently upward or downward, so as to form a large, plane permanent arc disk, capable of absorbing a great amount of electrical energy. This process seems to be specially available for producing nitrogen-oxygen compounds of air.

The Current Supplement.

A splendidly-illustrated and clearly-written article entitled "Portable Electric Drilling Machines" opens the current SUPPLEMENT, No. 1492. A new method for the conversion of peat into a fuel by electrical processes in such a manner as to be commercially valuable is described. Prof. Joseph W. Richards discusses in an interesting way the advance of electrochemistry. M. Emile Guarini continues his excellent account of the electro-metallurgy of iron and steel. The present installment of his article is fully illustrated by photographs of the apparatus described, as well as by clear diagrams. Dr. H. W. Wiley continues his summary of the borax experiments which he has conducted. The St. Louis correspondent of the SCIENTIFIC AMERICAN presents a very instructive account of the South at the World's Fair, illustrating his text with pictures of Southern State buildings. The Richard-Brasier car which won the Gordon-Bennett Cup is described. Besides these longer articles the SUPPLEMENT contains the usual assortment of interesting short paragraphs and the customary notes.

A Lackawanna Hudson River Tunnel.

It is definitely announced that the Lackawanna Railroad has decided to enter New York city by way of a tunnel bored beneath the Hudson River. The west mouth of the tunnel will be just east of the company's tunnel through Bergen Hill; this much at least seems certain. The Lackawanna's will be the third tunnel system to be built under the Hudson River.

There are 100 roads of one kind or another over the Pyrenees between France and Spain, but only three of these are passable for carriages.

Engineering Notes.

Hoisting engines may be said to be of two distinct types, viz., geared and first motion. Geared engines are used ordinarily where a hoisting speed of 800 feet or less is satisfactory, and first-motion engines where hoisting speeds of from 800 to 3,000 feet are required. The same load may be hoisted with the geared engines as with the first motion at a very much less cost for installation but at a sacrifice of speed. To hoist the same load the first-motion engines would necessarily have to be three or four times as large as the geared engines, the hoisting speed and cost increasing in about the same proportion. First-motion engines are now usually installed on all main hoisting shafts, although many geared engines are used on auxiliary shafts and slopes, particularly the latter, where it is desirable to haul heavier trips at a slower speed.—S. T. Nicholson in Mines and Minerals.

An electric traveling crane of exceptionally large size and capacity has lately been built by the Vulcan Company, of Stettin, for use on the construction docks, especially for transporting armor plate and heavy pieces of steel from the mills to the vessels in erection on the docks. The crane measures 175 feet long and 22 feet wide and is supported by two double pillars of steel trellis-work spaced 85 feet apart. The pillars each rest upon four wheels and run upon a track which passes over the whole length of the docks. Below the upper platform of the crane and inside the framework composing the cross-bridge, circulates the cabin or car of the crane proper, which is 6 feet wide and contains the motor-operated drums, which give the hoist and the lateral movement of the crane, besides the different electrical apparatus for the maneuver. Two motors are used to operate the crane. These are of the 3-phase type and work at 500 volts and 1,440 revolutions per minute, with capacities of 11 and 4 horse-power respectively. Gearing connects the motors with the drums. An overhead line runs along the track, and current is taken by a short-arm trolley which is fixed at the end of the bridge. The crane will lift 28 tons within the space of 85 feet between the pillars, but it has been tested as high as 40 tons.

The following is an interesting instance of the readiness of the Japanese Admiralty to profit by experience, and to lend a ready ear to the suggestions of private shipbuilders, even though it entails an abandonment of the plans of their own naval constructors. In 1888 a tender for the construction of a cruiser, the design of which they submitted, was asked from the Thames Iron Works and Shipbuilding Company, of London. Upon examination, the contractors found the design to be somewhat peculiar, and were reluctant to tender upon it. The risk to build according to the Japanese design was great, but to ignore it, and to tender upon their own substituted design, would have appeared a severe slight upon the Japanese naval constructor. After some consideration the contractors tendered upon the submitted design, but reserved the right to make any slight modifications in the plans, should their tender be accepted. The dimensions were as follows: Length between perpendiculars, 328 feet; breadth, 36 feet 6 inches; depth of hold, 19 feet 10 inches; draft of water, mean, 13 feet 6 inches; displacement, 2,133 tons; I. H. P., 6,000 forced draft for a speed of 19 knots. The order, however, was eventually placed in France, and the vessel foundered on her voyage out to Japan. When, therefore, the Japanese government placed their contracts for the "Fuji" and "Shikishima" some years later with this firm, they left the design entirely to the builders.

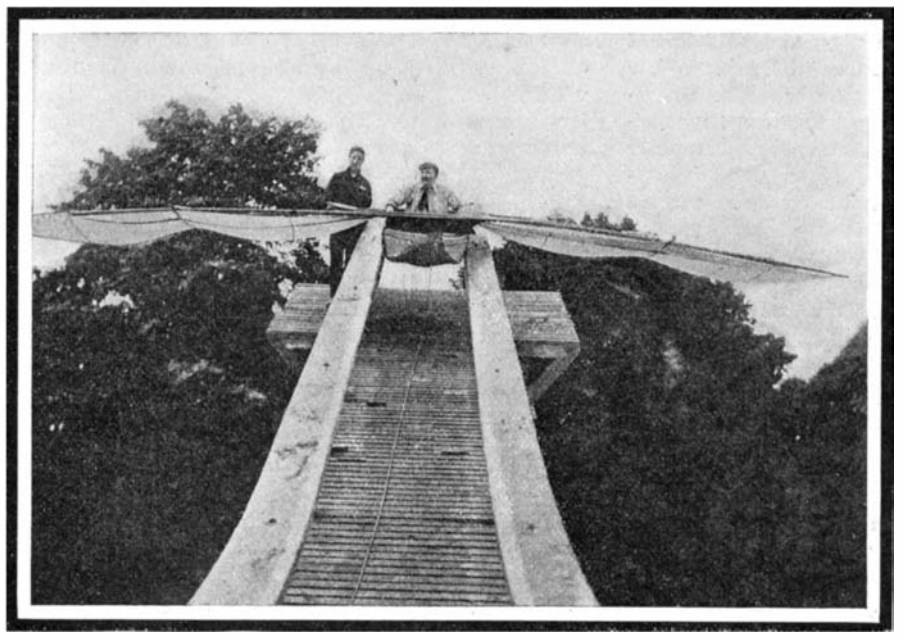
Owing to the high standard of efficiency to which the gasoline motor propelled boat has been developed, its utilization for naval purposes has been advocated. In a recent issue of the SCIENTIFIC AMERICAN SUPPLEMENT we published the report of a lecture upon the subject delivered by Mr. Thornycroft, the well-known English naval constructor, in London. The British Admiralty has now decided to create a class of motor torpedo boats upon the lines explained in the lecture. Each vessel is to be 130 feet in length, and will be armed with a deck torpedo tube, that can be trained all round, so that the weapon can be discharged in any direction. The motors will be placed below the waterline, and covered with a protective deck. The main advantage possessed by the motor torpedo boat over the steam-propelled vessel is the absence of smoke and funnels. This renders it more difficult of detection at night time, and also more effective for use in an attack under cover of darkness. If the experiments with this class of boat prove successful, the employment of gasoline motors in the torpedo picket-boats carried by battleships is also to be developed. The Admiralty will in all probability adopt the same type of gasoline motor as that in use upon the submarines, as this motor has proved highly efficient. There is one great objection to the employment of this type of motor, and that is the highly inflammable nature of the fuel. The penetration of the gasoline reservoir upon the boat by a shell would inevitably result in a conflagration, and the destruction of the boat.

AEROPLANE EXPERIMENTS.

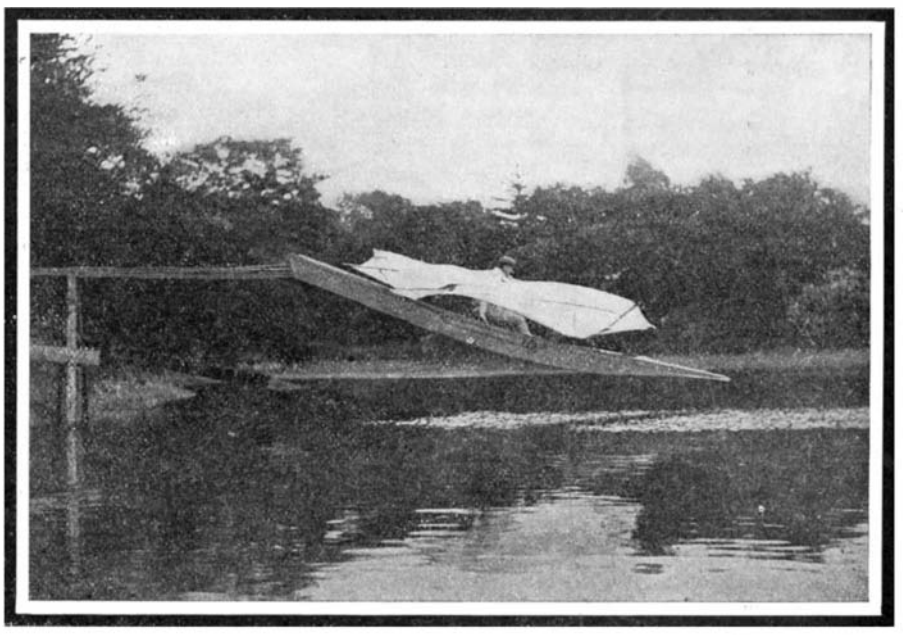
BY MAJOR B. BADEN-POWELL.

I recently published a description of the apparatus which I have erected at the Crystal Palace for giving initial impulse to a man-carrying aeroplane in order to test the balance and steering arrangements. Since this account appeared many more experiments have been conducted, although we have learned what a vast amount of small details need alteration and adjustment before good results can be obtained. Repeated trials showed that the boat sliding down between the inclined rails did not nearly attain the speed which it should have accomplished according to theory, and it was only after many days that one cause of this was discovered. Although the gage of the track had been carefully tested on completion, and though the inside of the rails appeared to be perfectly straight, a subsequent measurement of the gage, after the structure had been subjected to many days' alternate sunshine and rain, proved that the wood had swollen and warped so that there was a slight contraction about half-way down. This was just sufficient to cause the boat, in its descent, to become slightly jammed between the rails, but not sufficient to stop its way, so that to all appearances the apparatus simply ran very slowly. This difficulty was, of course, soon overcome by planing away about ¼ inch from the inside of the rails. Then various trials with different forms of lubrication for the runners showed difficulties with this method, and resulted in the application of small wheels to the sides of the boat in place of the oak runners. The track itself was also altered, as it was found that the "take off" at the lower end was rather too steeply inclined and detracted from the speed. On June 8 the first trials were made with a man in the boat, and several fairly successful descents were made, both by Mr. J. T. C. Moore Brabazon (who has kindly given me most valuable assistance in these trials) and by myself. The size of the aeroplanes used on this occasion was insufficient to make a good glide, the total weight of the apparatus amounting to some 270 pounds, and the area of the aeroplanes (each 12 feet by 5 feet 6 inches) to only 132 square feet. It was considered desirable to try the apparatus with this small aeroplane, with the object of testing the strength of all parts, and in this respect the results were most satisfactory. The boat, consisting of rough boards and battens screwed and nailed together, covered with canvas, stood a lot of very rough usage, and scarcely suffered at all from its plunges into the water. The aeroplanes were of thin cambric, stretched on bamboos of about 1½ inches diameter at the butt ends. These were fixed to the boat, but otherwise not stayed or trussed in any way; and though they bent upward considerably during the descent through the air, proved to be amply strong for the work. By constructing the wings on this principle, instead of so staying them as to be rigidly horizontal, an advantage was gained in that while on the track the ends were not caught by any side wind, yet, while supported in the air, a considerable diedral angle was formed which gave the desired transverse stability. On June 13 some larger aeroplanes were fitted. These were of hexagonal shape (being, in fact, constructed of old man-lifting kites), and were each of 118 square feet area. The arrangement may be seen in the last photograph. The lower end of the track had now been altered by removing the end support so as to allow the ends to droop. This is shown in the two photographs of the apparatus in the air, the boards having sprung back into the horizontal position after having been depressed by the weight of the boat. As the boat left the track, it was canted forward so that it shot downward into the water too abruptly to make a good glide. There was, moreover, on this occasion a considerable head wind, which often interfered to some extent with the apparatus attaining a good speed, but which was not found to be so serious as might be thought. The usual time of descent from the top of the track to the take-off was just 3 seconds, being sometimes extended to 3½ seconds. On June 18 further trials were made, after a number of minor improvements had been effected. The lower end of the track was now rigidly supported and set so as to be exactly horizontal. A triangular "beak" of 18 square feet was spread in front of the same hexagonal aeroplanes, and some fairly successful glides were made, although, of course, the weight per area (1.24 pounds per square foot) was still very excessive when compared to the proportions which previous experimenters with aeroplanes have applied.

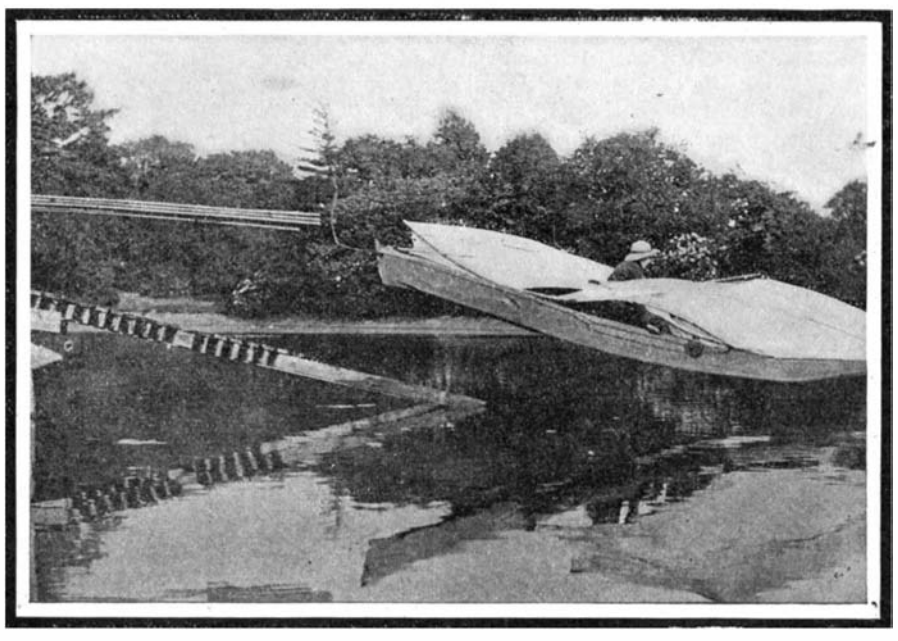
Now that the general arrangement and practical working of the apparatus has been well tested, it will be possible to make more exact trials. It is proposed to fit on an upper aeroplane and other additions to make the total supporting surface up to some 430 square feet, and it then seems probable that we may be able to make some useful glides, full accounts of which I hope to send in for the next number.—Knowledge and Scientific News.



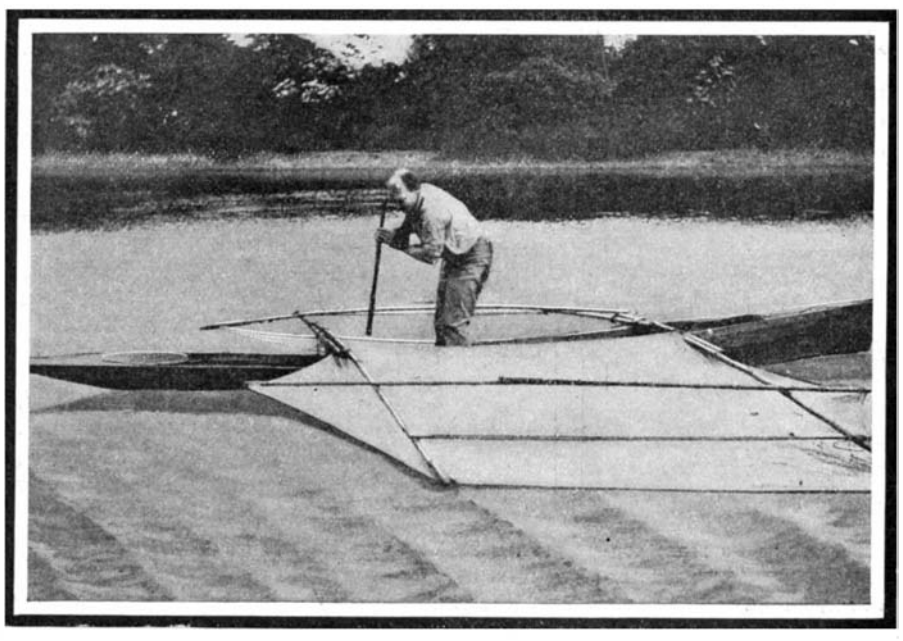
Ready to Start.



The Aeroplane in Mid-Air.



Gliding Along.



Paddling Ashore After Descent.

MAJOR BADEN-POWELL'S AEROPLANE EXPERIMENTS.

An Important Invention in Textile Machinery.

An invention has just been perfected that will, without doubt, attract the attention of the textile manufacturing world. It is a warp-twisting machine that fastens the ends of two warps by twisting the single threads together. It is designed to do away with the present method of twisting by hand, which is necessary in order to fasten the ends of the warp in the loom to those of the new warp without taking the former out of the shafts.

The inventor is Mr. Gustav Hiller, of Zittau, a prominent manufacturer. The machine represents six years of patient labor, and has become an accomplished fact after repeated failures. I am informed by manufacturers and experts thoroughly conversant with this branch of manufacturing industry that there is at present no such machine in use, or at least none that has proved entirely practical. The history of many patents on machines designed to perform this work seems to be a history of failures.

Both warps are put into the machine with cross rods so that they are directly opposite each other, and the ends are held together by a press, which is lifted by the machine, in order to slacken the warp, at the moment that the two threads which are about to be fastened together are taken into the twisting apparatus. The machine works automatically—takes a single thread from each warp, cuts them, and twists them firmly together.

This machine is applicable to all classes of yarns, be they cotton, wool, linen, or silk. It is able to twist about 2,500 ends in an hour, whereas a good hour's work for an expert twister is 800 to 1,000.

Considering that the machine does the work of about three experienced twisters and can be operated by an inexperienced workman, the advantage of its use is very perceptible, and it will no doubt quickly supersede the old method, especially where plain and dobby looms are largely used.

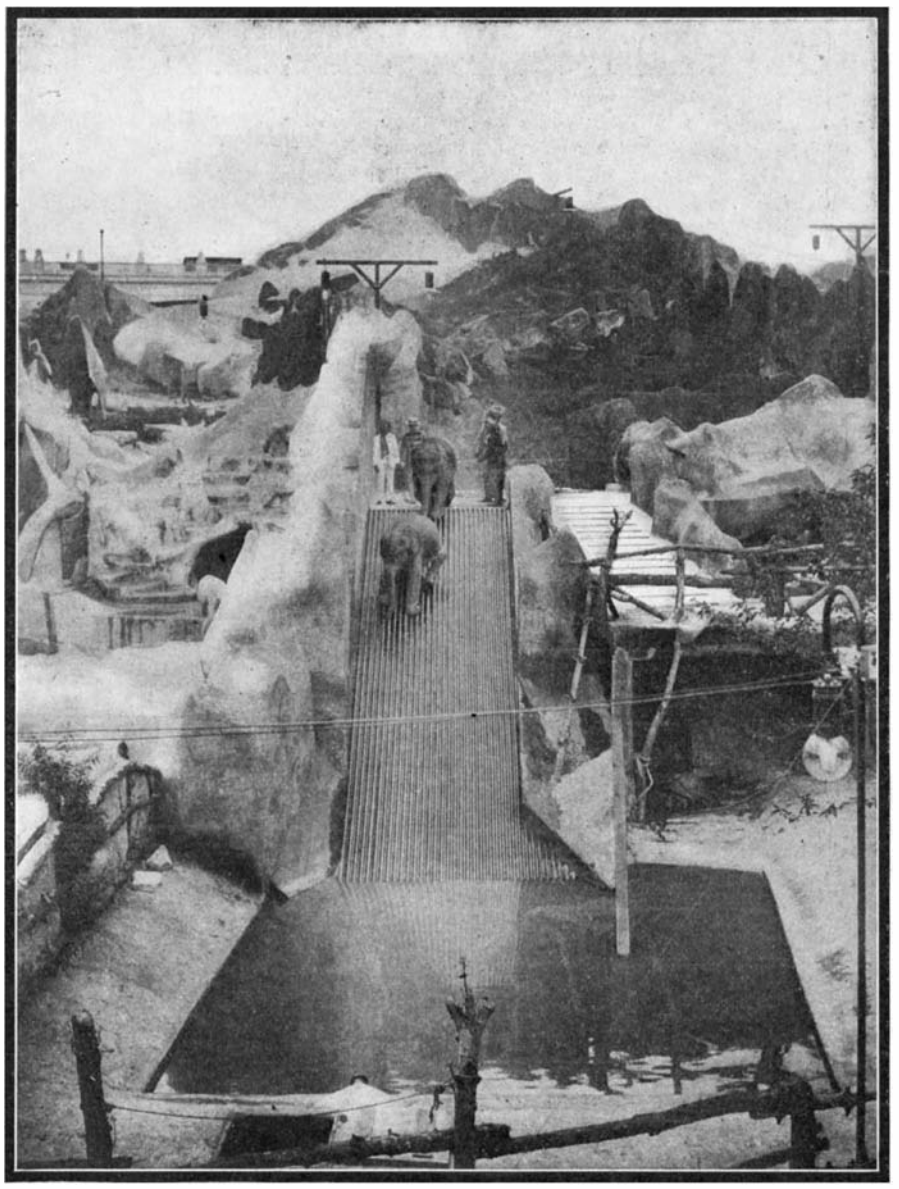
An olive tree containing 1,000 incandescent electric lights is a part of an olive oil display in the Agriculture building at the World's Fair.

TRAINED ANIMALS AT THE WORLD'S FAIR.

BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

No great exposition like that now being held at St. Louis would be complete—not, at least, in its amusement features—without a display by the great animal trainer and specialist, Hagenbeck; and his present exhibit, which forms one of the most notable features of the "Pike," is the largest and in many respects the most interesting of any that have been shown by him at any of the great expositions. It is not our purpose to give any comprehensive description of this exhibit, but rather to point out the new features which lend it special interest. Most conspicuous of these is the large open-air panorama, in which a most successful attempt has been made to cage a motley assemblage of wild animals that are in their native state bitterly hostile to each other, in a common inclosure, and to reproduce in this inclosure a facsimile of the dens, lairs, mountain fastnesses, and gorges which the wild animal loves to frequent when roaming at large. At the time our front page photograph was taken, there were thirteen of the animals within range of the camera, and it will be noticed that their positions and actions are perfectly natural. The group includes seven bears, four lions and cubs, and two fine specimens of the Great Dane.

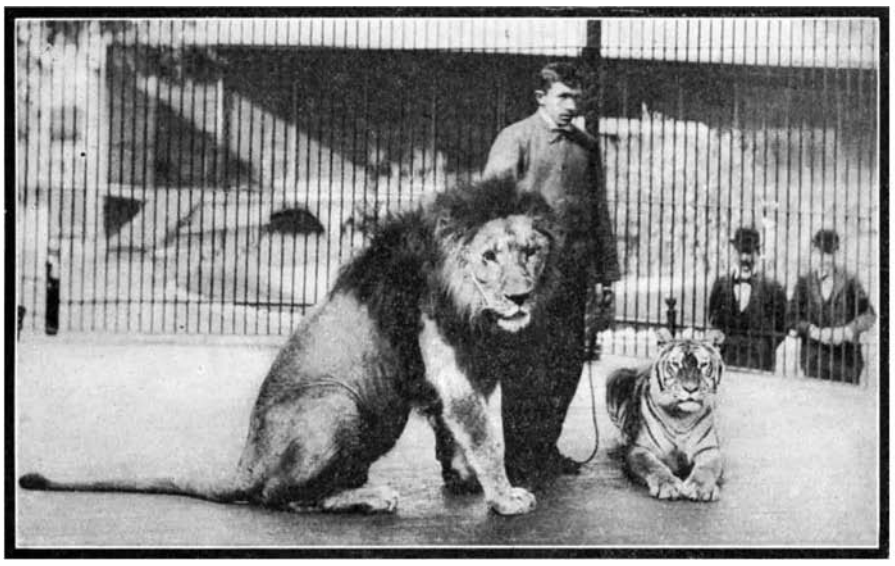
A decided novelty, which forms part of the mass of natural scenery above referred to, is a wild animal "shoot the chutes." There is something extremely incongruous in the idea of this very modern and thoroughly human form of sport having any attraction for the beasts of the field; but as a matter of fact several of Hagenbeck's collection have taken very kindly to the chutes, none more so than the elephants, and particularly the smaller baby elephants. The slide is covered with longitudinal bars of iron, to give the necessary sliding facility, and it is more than comical to see the elephants bravely mount to the top, plant themselves on the slide and make the wild sweep into the deep pool of water below.



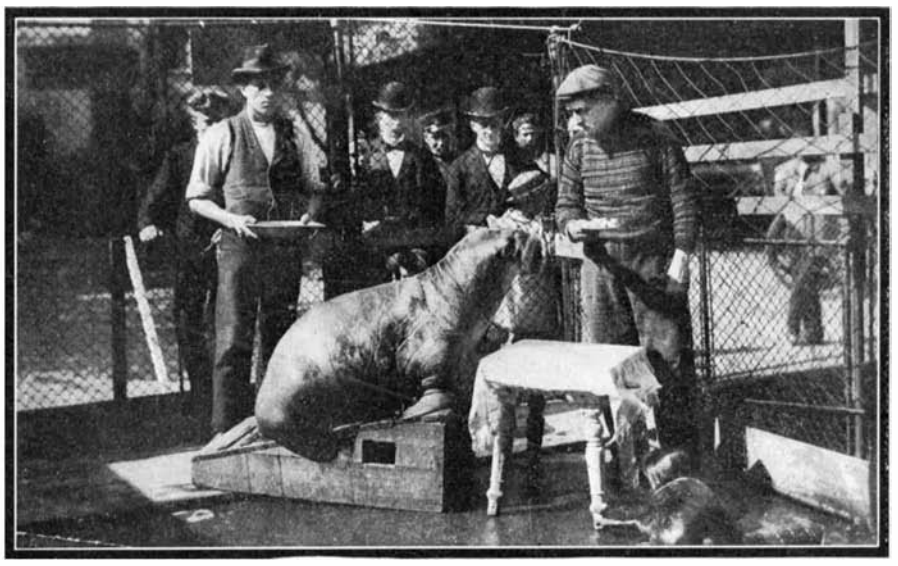
Baby Elephants "Shooting the Chutes."

It is not surprising that this reproduction of the mountain fastnesses and of wild beasts in their native haunts should possess great attraction for the various tribes of natives that are scattered throughout the St. Louis Exposition; and on various days, by the courtesy of the exhibitor, the inhabitants of the various tribal exhibitions have been invited within the Hagenbeck inclosure. None of the natives seem to enjoy this opportunity more than the Philippine tribes from the government exposition, and our photographer managed to get a good snap-shot showing a group of Igorrotes riding in an Indian car drawn by a pair of sacred bulls of India. The fine physique of this people, which has been the subject of so much comment at the Fair, is shown in the figure of the native standing at the rear of the car.

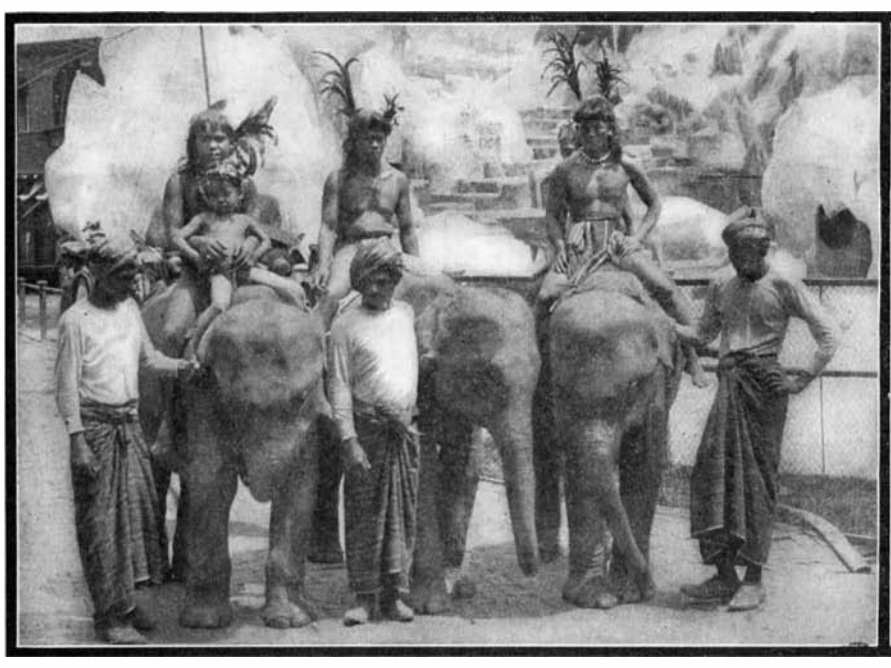
Several successful attempts at the production of hybrids have been made by Hagenbeck, one of the most notable of which resulted in "Romulus" and "Remus," the offspring of "Roland," a black-mane Barbary lion, and "Sarah," a Royal Bengal tigress. These cubs, which are only four years old, are magnificent specimens; they are already as large as their mother, and are much larger than the cub of the regular species. We show a picture of "Roland," the father, taken when he was



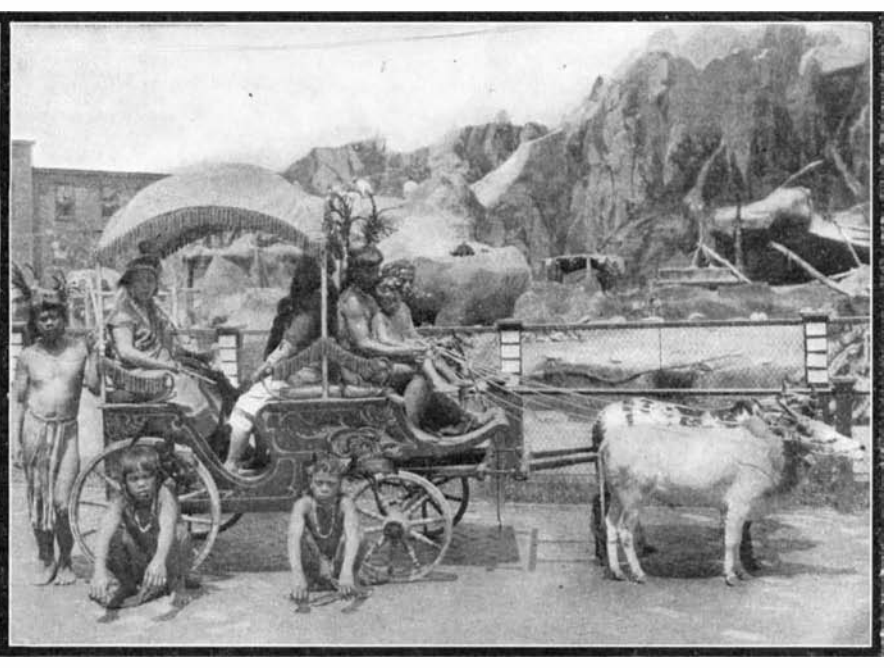
"Roland," the Black-Maned Barbary Lion.



The Trained Seal at Breakfast.



Igorrotes from Philippines Riding Baby Elephants.



Philippine Igorrotes Riding in an Indian Car Drawn by Sacred Zebra Bullocks.

WITH THE TRAINED ANIMALS AT THE FAIR.

on the stage of the amphitheater. The breeder of live stock is specially interested in the hybrid offspring of the horse and zebra. He has the valuable quality of being wholly immune to the bite of the dreaded tsetse fly, and because of his value in foreign service he is being introduced into the German army by the Emperor William.

Another novelty of great interest is a baby elephant which is undoubtedly the smallest specimen that is known to exist. This little creature, which was born on May 10, 1904, is remarkable for the fact that at the time of its birth it weighed only 87 pounds and stood only 27 inches in height. Its great value as an exhibition specimen is realized when the layman is told that it is customary for an elephant to foal a calf weighing from 170 to 200 pounds. When the little fellow left Hamburg, Germany, he carried a life insurance of $75,000, and mother and baby were required to pay a first-class passage of $475 between Hamburg and New York. The little fellow traveled in an ingeniously fashioned cradle, which was swung from a supporting bar, with the idea of preventing any rough knocks or bruising due to the motion of the ship. The cradle was padded with eiderdown on all sides, and within the cradle was constructed a separate department for the Hindoo keepers, who relieved one another in keeping watch over the remarkable youngster.

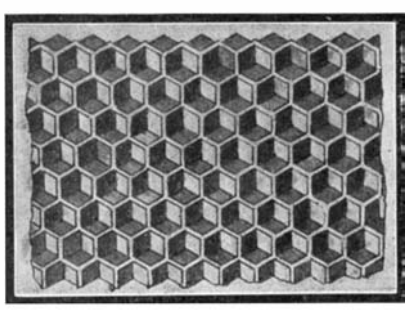
Before closing our mention of this exhibit something should be said of the collection of baby wild horses of Mongolia. These creatures are among the most shy and hard to get at of all wild animals, when in their native state; but, by dint of patience, it has been found possible to tame some of them, and a number are exhibited at the fair.

THE BEE AS AN ARTISAN.

Nowadays, in agricultural, and even in horticultural competitions, bee-culture has generally a prominent place assigned to it, and rightly, too, since the importance of the valuable services that the bee is daily rendering is apt to be overlooked or underestimated. This insect, in fact, supplies us with two very valuable products—honey and wax; while in agriculture, it contributes largely to the fecundation of flowers, and to such an extent, too, that at the present time, in America, almost every large farm has a number of hives. It adds to the profits of the intelligent husbandman, with scarcely any expense, and requires of him in return but a slight amount of care. Bee-cultural exhibitions are multiplying, and every farmer does his utmost to present thereat the finest products of this beneficent insect.

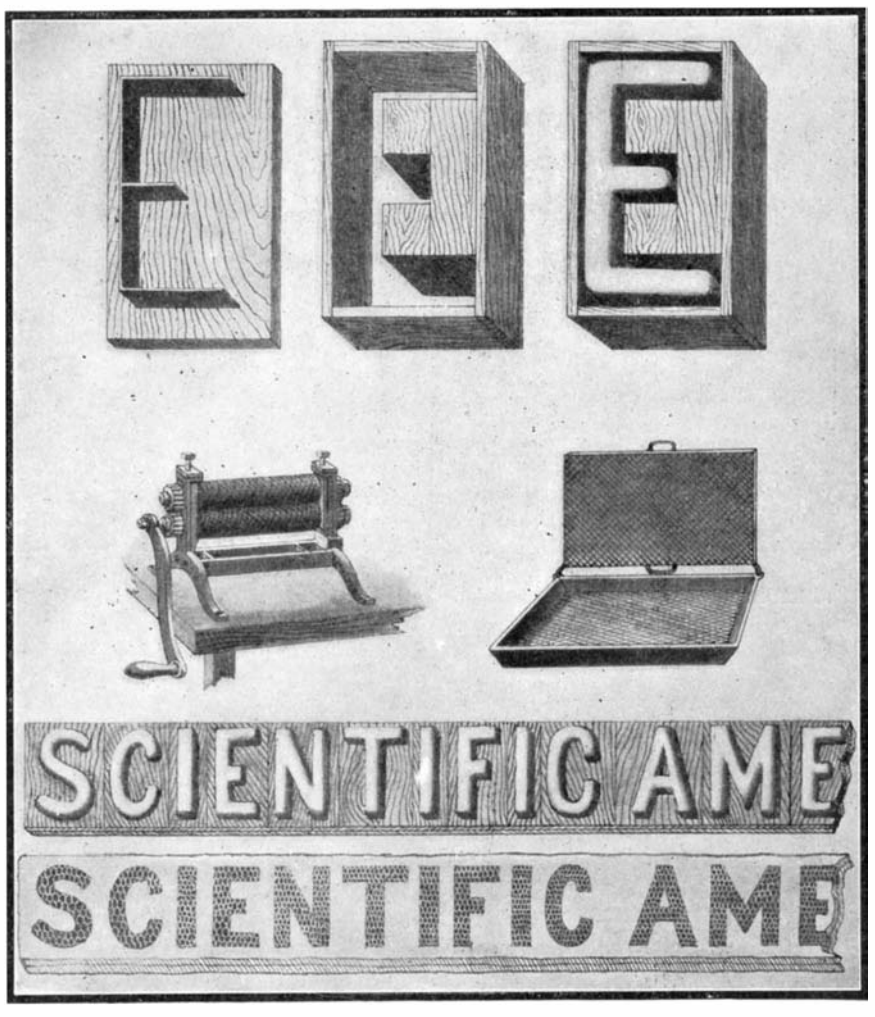
One of the attractions to which bee-culturists often have recourse consists in signs bearing their name or some device formed of honey comb. People stop and gaze at these and then go away wondering how the thing is done, and doubtless thinking that it is by some process of molding like that employed in the manufacture of pastry. A closer examination, however, will show the visitor that the objects are formed of cells of wax full of honey and closed by their natural operculum, as in the honey comb taken from the hive.

The letters that compose the inscriptions we illustrate were, in fact, constructed entirely by the bees, and by them alone filled with honey. In doing this, however, they in nowise gave any proof of art or intelligence, but blindly obeyed the will of their master, who at the moment that it became incumbent upon them to construct cells in which to store their valuable product, caused them to give their constructions whatever form pleased him. This he did through the use of "goffered wax;" that is to say, wax in thin sheets containing impressions having the form that is exhibited by the base of the cells in the comb of the bee. Such wax is obtained by molding it in a goffer-iron or passing it between two cylinders, one presenting in depression and the other in relief the form of the base of the cells. If the sheet is to be of limited dimensions, it is formed by dipping a water-cooled plate into a bath of molten wax. If it is to be of large dimensions, it is manufactured by a method that permits of giving it an indefinite length. Through goffered wax, modern bee-culture has been enabled to make very great progress. It was invented in 1857, after persevering experiments, by John Merhing, a Bavarian bee-culturist. Peter Jacob, a Swiss, afterward improved the Merhing press, and, in 1865, a Mr. Steele, of New Jersey, imported goffered wax into the United States, where, in 1876, a Mr. Root had a cylinder machine constructed, and the use of the wax rapidly spread throughout the world. One of its advantages is that the bee can be forced to construct according to plans laid out for it, and to form a comb with parallel sides that can be easily removed from the hive and emptied by means of centrifugal force apparatus called "extractors." A pure and limpid honey is thus obtained with astonishing rapidity, and that, too, without breaking the comb, which is put back into the hive to be again filled by the bees. The latter are thus enabled to employ the time that it would have taken to construct a new comb in the gathering of a new crop of honey. This, of course, affords so much more profit to the bee-master.



Fragment of a Sheet of Goffered Wax of Actual Size.

It therefore suffices to suspend the sheets of goffered wax in frames to have the bees hasten to utilize them in constructing the lateral walls of the cells, provided the wax used in the manufacture is absolutely pure, since if it is not, the insects will not use it, but will endeavor to cut it in pieces and throw it out of the hive. It is this readiness of the bees to follow the plan laid out by the bee-master that is taken advantage of by the latter to cause them to give their combs the most unexpected forms. It suffices for this to secure sheets of goffered wax at right angles to a board by means of glue or melted wax, and afterward surround them with a mold in such a way as to leave just enough space for the bee to construct its cells and move about in. The most fitting width to give such space is indicated by that which is observed between the combs in hives. The whole is placed upside down (that is to say, the board uppermost) in a hive, and the bees soon install themselves in it. The upper part of our illustration shows a board provided with sheets of goffered wax, the mold, and the mold filled by the bees with honey comb in the shape of the letter E. At the bottom of our illustration the letters, which have been obtained isolatedly, are shown fastened to a board by means of screws. In order to conceal the joints between the letters, the boards are covered with cloth or velvet. The letters at the extreme bottom of the cut were hollowed out of a honey comb by bees. They were obtained by covering the comb with a thin sheet of paper or metal out of which the letters had been cut. The bees then uncovered the cells corresponding to the exposed parts and emptied them of their honey, and after this the sheet of paper or metal forming a pattern was removed. This is how bees, simple laborers for man, become artists in spite of themselves, and sometimes construct their comb in truly curious forms, such as rings, stars, flowers, fruit, etc., through the intermedium of complicated molds and the exercise of great patience. The laborious insects are, however, often so discouraged by the complications of the molds that they have to make many attempts before reaching the result desired.—Translated from La Nature for the Scientific American.



MOLDS AND TOOLS FOR CAUSING BEES TO MAKE LETTERS IN HONEY COMB WITH THE AID OF GOFFERED WAX.

Chemical Composition of Igneous Rocks.

The United States Geological Survey has published as Professional Paper No. 18 a discussion, novel in its form, of a complex subject, which is fully explained in the title: "Chemical composition of igneous rocks, expressed by means of diagrams, with reference to rock classification on a quantitative chemico-mineralogical basis." The author is Prof. Joseph Paxson Iddings, of the University of Chicago.

The materials, erupted from the depths of the earth, vary greatly in composition. Silica, alumina, iron, magnesia, lime, soda, and potash are present in considerable amounts in most eruptive rocks, and other substances often occur in notable quantities. The mineralogical composition and, through that, various other features of igneous rocks, depend in large degree upon the chemical composition of the fluid magmas of which they represent the solid forms. It is, however, difficult, even for the specialist in this science, to readily perceive the significance of the differences in composition between two rocks when presented in the form of long chemical analyses; hence petrographers have for many years sought to express in the form of some diagram the principal facts of each analysis, so that they may at once appeal to the eye. Prof. Iddings describes the various kinds of diagrams that have been used, finally explaining the kind which seems to him the most useful. These diagrams express in very clear form the relations of all the leading constituents of an analysis. Prof. Iddings has also devised a plan for the comparison upon charts, of diagrams representing separate analyses, so that the full range of composition found for known igneous rocks is at once illustrated. This publication, presents these charts, which are printed in four colors and accompanied by descriptive text.

This graphic representation brings out many facts concerning the composition of the earth's magmas which are of much interest. The fact that there are no well-defined chemical groups of rocks, but rather a great continuous series with no natural dividing lines, is clearly illustrated. The author discusses the relations exhibited by the charts, with particular reference to rock classification.

The work is a valuable companion to the more extensive compilation of rock analyses, by Dr. H. S. Washington, recently issued by the Survey as Professional Paper No. 14. Both present a mass of data which was used in constructing the "Quantitative System for the Classification of Igneous Rocks," proposed in 1902 by Cross, Iddings, Pirsson, and Washington.

The Manchester Ship Canal (Finance) Bill of 1904, giving effect to the arrangements made between the Corporation of Manchester and the Canal Company, and to empower the Manchester Ship Canal Company to raise additional capital, has been issued by the Private Bill-office. The corporation are to accept 3 1-5 instead of 4½ per cent on their debentures, which are to be made irredeemable and incapable of transfer. The arrears of interest due to the corporation are to be extinguished, the company giving, in respect of them, pre-preference shares for the amount which the corporation is actually out of pocket, apart from the provision which has been made for the sinking fund. The company will also be empowered to raise $7,500,000 at once by mortgage with priority over the existing debentures.

Although steel containing about 5 per cent of manganese is so brittle that it can be pulverized under the hammer, yet an increase in the manganese content to about 13 per cent gives great ductility combined with great hardness—a remarkable combination of qualities—on account of which manganese steel is used for such purposes as rock-crushing machinery and mine car wheels.

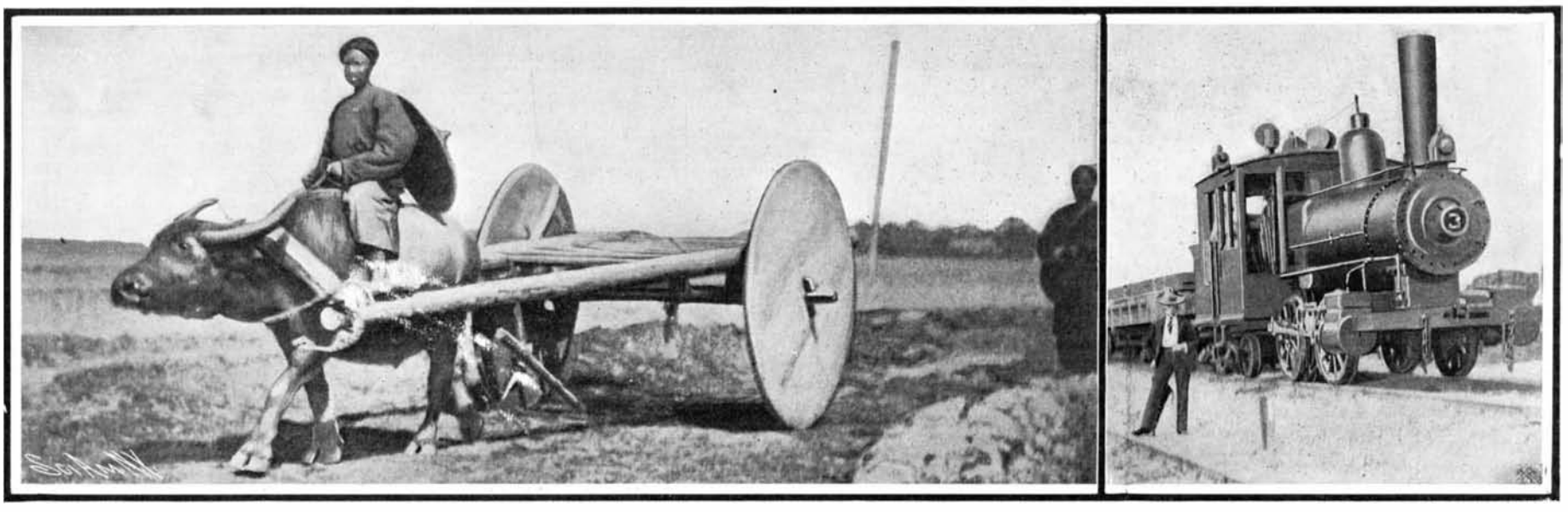
TRANSPORTATION OLD AND NEW.

BY REV. R. E. CHAMBERS, CANTON, CHINA.

The transformation that is slowly, very slowly, taking place in the industrial condition of the Chinese is suggested in the strongly-contrasted methods of transportation illustrated in the accompanying group of pictures. From time immemorial the Chinese have depended upon draft animals and man-power for the haulage of passengers and freight, when the transportation was to be done by land. For transportation by water they have been favored by the presence of navigable rivers, with which the country is abundantly supplied. It is to the vested interests of the river boatmen, indeed, that much of the opposition to the introduction of steam railroads has been due. One of our illustrations is reproduced from a photograph that was taken about 30 miles north of Canton, and represents the transporting of goods on wheelbarrows, a method of transportation by which a large amount of freight is carried annually to China. The outfit is distinctly a family affair, the man wheeling the barrow, and the woman going ahead and helping by pulling on a rope attached to the front of the barrow.

Modern Steel Cross Ties

Transportation by Wheelbarrows. Each Man Pushes; His Wife Pulls.



A Primitive Chinese Method of Hauling Sugar Cane.

A New York Elevated Railway Engine Now Used in China.

Another illustration shows a cart of the kind used in hauling sugar cane from the fields to the factory. It will be noticed that the construction of the cart, as of the barrow, is of the most primitive kind, the shafts of the cart being unhewn poles and the wheels apparently built up of planks of wood.

Two of the photographs were taken on the Canton-Hankow Railway, a branch of which is now nearly completed from Canton to Sam Shui, a treaty port on the West River, 30 miles west of Canton. One of the views shows a pile of steel cross ties, of the kind which are used in the track from Canton to Fatshan. The flag which floats over the ties bears the name of the Chinese colonel of the soldiers that protect the railway from injury by the natives. A peddler of sugar cane was plying his trade just in front of the ties, but fled when he saw that his picture was about to be taken. His scanty wares may be noticed in the foreground.

Perhaps the most interesting view of all, at least to New Yorkers, will be that showing a locomotive attached to a train of cars; for they will recognize the well-known outline of one of the three or four hundred engines which, for so many years, did good service on the Manhattan elevated railways before the introduction of electric traction. These little engines, which, in spite of their long service, were in excellent condition, have been scattered all over the world, and eight of them are now used for hauling passenger trains between Canton and Fatshan, a distance of twelve miles. Twelve trains are run each way daily, and when it is remembered that Fatshan has a population of between one and a half million and two million people, it can be understood that the traffic is very heavy.

Production of Galalith.

Consul-General Hughes, of Coburg, furnishes the following additional information regarding "galalith, or milk stone," on which subject the SCIENTIFIC AMERICAN published an article.

Galalith is of about the same hardness as horn, but it is a little more brittle. In order to bend it, it is necessary to place the material for about ten minutes in cold water; then it is put for five, ten, or even fifteen minutes—depending upon its thickness—into boiling water, or, better still, into mineral oil at a temperature of from 80 deg. to 100 deg. C. After that the galalith can be bent easily, but this must be done gently and not by jerks. When heated, the finest impressions can be made on it. It is polished in the same way as horn—i. e., after having carefully smoothed its surface with the help of sandpaper, it is polished by the application of plenty of water, some oil, fine pumice stone, and gray tripoli. After this it is dried by rubbing with a coarse cloth, and then with the help of a pad a little green soap and Vienna chalk is rubbed on. The brilliant polish thus obtained is glassy and nicer and more durable than that of horn. Galalith is of about the same weight as celluloid; it is lighter than hard rubber of a poor quality, but slightly heavier than articles made of hard rubber. Unlike celluloid, it cannot be chipped with a knife; but, the same as horn, it must be cut by means of a fine saw.

Like tortoise shell, it can be soldered, and by means of a specially-prepared glue it can be fastened on celluloid, wood, tiles, and metal. A great variety of articles are manufactured out of this new material by the Vereinigte Gummiwaarenfabriken at Harburg and Vienna, as, for instance, handles for canes and umbrellas, combs, cigar holders, various ornaments for ladies and gentlemen, etc. Quite recently galalith has also been employed in the manufacture of furniture; on account of its beautiful shades, particularly marble colors, galalith is used for framing the valuable and very delicate iridescent glass; it being also furnished in tubes, it can be used in the manufacture of parlor or onyx lamps.

The manufacture of galalith takes from two weeks to three months, depending on the required thickness; at present it is rolled in plates of a thickness of 2 millimeters (0.078 inch), and 50 centimeters (19.68 inches) by 80 centimeters (31.2 inches) in size; staves of a thickness of 3 millimeters (0.12 inch) and more, and tubes are not rolled, but drawn. This is done in the works at Wimpossing and Harburg on the Elbe. In the latter place a large factory for the production of galalith is in course of construction.

Remarkable Hoisting.

At the De Beers Mine in Kimberly, some very remarkable work has been done in the hoisting line; establishing a wonderful record in the way of capacity for hoisting from a single shaft. The hoisting engine consists of a pair of vertical, tandem, compound, condensing engines, operating with 120 pounds of steam, hoisting from the 1,200-foot level, making a total lift of about 1,260 feet. Two automatic dumping skips, 5 feet x 3 feet and 6 feet deep, are used, each weighing 4,400 pounds and holding 9,600 pounds of rock. The skip is loaded at the bottom by tipplers worked from the chute by a hand lever, and the rapidity of handling is shown by the fact that as high as 92 skip trips have been made in 1 hour. On one occasion during a single shift of 11 hours and 43 minutes the weight of rock hoisted was 3,665 tons, or at the rate of 7,400 tons in 24 hours. This record was broken by the same plant a year or two later by hoisting 5,300 tons in 12 hours, and on May 17, 1899, 9,261 loads of blue ground, equal to 7,400 tons of 2,000 pounds each, were hoisted 1,260 feet by this engine, working in two compartments, in 24 hours. Of course this is not their regular every-day working, but special running to show what can be done. The skips are loaded at the bottom so quickly that the engineer sometimes receives the signal to hoist before he has completely stopped the engine.—J. S. Lane in Mines and Minerals.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

GUARD FOR INCANDESCENT LAMPS.—C. W. EISENMANN, Julian, Neb. The object of the invention is to provide a new and improved guard, more especially designed for protecting the glass bulbs of incandescent lamps and which is simple and durable in construction and arranged to permit convenient attachment to the bulb. The guard is readily placed in position and is wholly supported from the bulb itself.

Of General Interest.

PARQUETRY FLOOR.—C. M. KREBS, New Albany, Ind. The aim of the invention is to provide a floor not liable to warp or become disjointed, adapted to be quickly laid on an old or new wood subfloor, and arranged to secure nailing of the blocks and securing other exposed parts so that no nails or other fastening devices will be exposed to view, and to allow finishing of the parts of the floor at the shop, so that after assembling an even and level surface is produced and no further planing, scraping, sand-papering, puttying, or varnishing is necessary. Mr. Krebs has invented another parquetry floor to be completely manufactured in the factory, to leave as little work as possible for the floor layer, and adapted to readily bridge over existing short abrupt inequalities in a subfloor-surface, and to conform to gentle undulations, if any, in the subfloor, and prevent undue warping of the floor and its parts from becoming disjointed.

JEWELRY-PROTECTOR.—A. LANDAU, New York, N. Y. Mr. Landau's invention relates to protectors for jewelry and the like, being more particularly applicable to watches. It has for its principal objects the so securing of such articles to the clothing of the wearer that while they may be readily detached by him they cannot become accidentally displaced nor easily snatched by thieves.

SLEEVE-DRAPER.—ETTIE LESSER, New York, N. Y. This invention has for its object the construction of a form which shall be more efficient and capable of easier handling and manipulation than prior devices of this character. The form shall be made of material which will permit an openwork construction, so that when the sleeve is adjusted upon the form it may be served from the interior, the open spaces affording access to the material for the proper manipulation of the material and of the drapery or trimming.

KNOCKDOWN BOX.—J. LUCAS, Charleston, S. C. In this patent the invention relates to improvements in that class of pasteboard boxes known as "knockdown" boxes; and the object is to produce a box of this character which is cheap to manufacture and when up is stronger and more durable than any now known or used. There are no projecting corners to catch, as in the ordinary form of knockdown box.

ANKLE-BRACE.—H. LUECK, New York, N. Y. The invention relates to ankle-braces adapted to be applied to shoes and intended to assist children in keeping their ankles straight when learning to walk and afterward until the ankles acquire their sufficient strength, and may also be worn by any and all persons having weak or injured ankles. The invention resides in the peculiar arrangement of combined cushioning and strengthening pads with respect to the shoe so that the brace may be used or not at will and when used forms an elastic inclosure for the ankle.

COMPRESSION-INDICATOR FOR CALIPERS. C. C. MCCLAUGHRY, Atlanta, Ga. In this instance the purpose is the provision of a scale attachment for calipers and a pointer for the scale automatically carried across the scale as the measurement is taken and automatically returned to zero when the calipers are removed from the object, thus enabling a machinist, for example, to determine by sight when two or more objects are alike.

NON-REFILLABLE BOTTLE.—G. G. ROSS, Seattle, Wash. In this patent the inventor Mr. Ross has for his object the provision of certain novel details of construction for bottles used to put up for sale certain quantities of a vendable liquid—such, for example, as a popular brand of whiskey, brandy, wine, or the like—which will prevent the refilling in part or entirely of the bottle when emptied, and thus effectively prevent adulteration of the liquid or substitution of an inferior kind for that originally held in the bottle.

TRAP.—A. ZEIGER, New York, N. Y. This invention seeks to overcome a disadvantage in the usual S-trap used in plumbing and the like, and in carrying it out the inventor provides a trap with a cross connection running in its upper bend at a point above the waterline in the trap, this connection forming, with the upper bend, a divided passage from the lower bend, and thereby preventing that suction of the water in the lower bend which will result in siphoning out the said water.

BLIND-LOCK.—R. H. ASHMORE, Jefferson City, Tenn. In this patent the invention relates to novel and effective means for securing blinds at closed position and whereby they are rendered more secure against being opened on the outside. Before the very efficient securing means employed could be unfastened from the outside of the blinds, it would render necessary much cutting away of the blind by an intruder.

GAGE AND MARKER FOR GARMENTS.—A. R. WATERMAN, New York, N. Y. The purpose of the invention is the provision of a marking device and gage for garments adapted to expeditiously and accurately mark any garment which is to be taken up or shortened, the device being especially adapted for shortening or evening the bottom portions of skirts, coats, cloaks, or dresses of all kinds and sizes, whereby when a hem is to be made at the bottom of the garment or the garment is to be shortened the marking will be an even distance from the floor all around the garment.

PROCESS OF MAKING SULFURIC ACID.—A. L. STINVILLE, 10 Rue Chimonnier, Paris, France. Mr. Stinville's object is to secure the same results as those obtained by the Lunge tower—that is to say, the increase of the quantity of acid manufactured in a given system of lead chambers, while diminishing considerably at the same time the quantity of water-vapor injected for the reactions and doing away entirely with or reducing to a minimum the inconveniences offered by the towers.

RULE-GAGE.—H. MCKECHNIE, North Seattle, Wash. The invention relates to improvements in gages or templets to be used in connection with a pocket-rule or the like in marking lines parallel with the edge of boards; and the object is to provide a device in which a person may place his finger while moving the rule along the board and prevent the finger contacting either at the side or end with the rough edge of the board, thus protecting the finger from splinters.

Heating and Lighting.

GAS-BURNER.—W. C. OBERWALDER, New York, N. Y. The prime object of the improvement is to provide a burner adaptable particularly to incandescent mantles, and in which the mixture of air with the gas to produce a Bunsen flame will be uniform and automatically regulated, according to the pressure of the gas, and also a burner in which there will be no danger of back-flashing of the flame or of interference with the flame by currents of air.

Hydraulics.

SAFETY CONTROLLING-GEAR FOR FLUID-PRESSURE ENGINES.—E. CROWE, Birchholm, Bushey Wood, Totley Rise, Sheffield, England. Mr. Crowe's invention relates to apparatus for automatically closing a stop-valve situated on the pressure-pipe leading to the engine when the engine attains or excels a certain speed, and has for its object the prevention of breakdowns consequent on accidental derangement or failure of the ordinary governing or controlling gear, or (in case of an engine hand controlled) in consequence of negligence or inadvertence of the engine-driver.

Machines and Mechanical Devices.

APPARATUS OPERATED BY A PERFORATED BAND FOR CASTING SPACES.—M. WEHRLIN, 74 Rue de la Victoire, Paris, France. In this patent the invention relates to improvements in machines for casting and composing movable type of the kind described in the English Patent No. 18,542. Mr. Wehrlin's invention has for its object to simplify the device for the making of spaces to justify automatically the lines.

AUTOMATIC CLUTCH FOR TYPE CASTING AND COMPOSING MACHINES.—M. WEHRLIN, 74 Rue de la Victoire, Paris, France. Practice has brought to light a defect in the machines described in the English Patent No. 18,542—viz., that it is always necessary to be on the lookout when the last line of the registering-band is approaching and to stop the machine at the proper time just after the casting of the last character to prevent the machine, and particularly the piston, from running idle. The present invention relates to an arrangement whereby the casting-machine will be brought automatically to a stop after removal of the last line of composition, which will allow the attendant not to busy himself at all about the approach of the last line.

TYPE CASTING AND COMPOSING MACHINE.—M. WEHRLIN, 74 Rue de la Victoire, Paris, France. In movable-type casting machines operated by means of register-bands, in the course of a certain operation it has not been possible to produce at the same time as the usual printing-type a second sort of writing, called "distinguishing" printing-type, whereby a varied composition might be made. This invention relates to a device whereby without increasing the number of perforations (combinations of perforations) of the registering-band or the number of dies, and consequently the number of brackets supporting the same, it becomes possible to compose besides the usual printing-type a second sort of printing-type called "distinguishing" printing-type.

ORE-CONCENTRATOR.—S. BEER, Butte, Mont. Mr. Beer's invention relates to improvements in mills for separating the values from gold or other ores, an object being to provide a device of this character that may be built to set up at a comparatively small cost, that may be easily operated by water-power, and in which there will be but little wear and tear.

LEMON-SQUEEZER.—W. H. GREGORY, Vallejo, Cal. This improvement relates to a device provided with a magazine or storage-bin in which lemons, limes, and other like fruit may be stored and with mechanism below this bin for cutting and squeezing the fruit, so that by the operation of this mechanism the fruits may be successively cut and squeezed. It is especially intended for use at bars or places in full view of the customer.

FRUIT-SORTER.—J. B. CRUM, Homeland, Fla. In this instance the invention relates to improvements in machines for sorting oranges, apples, and similar fruit, an object being to provide a machine for this purpose of simple construction, and by means of which the fruit may be rapidly sorted and the various sizes discharged in different piles or receptacles.

COTTON-CLEANING MACHINE.—E. J. GARDNER, Shawnee, Oklahoma Ter. In carrying out this invention, Mr. Gardner has particularly in contemplation the correlation and arrangement of certain elements by which all dirt, leaves, and hard substances will be separated from the cotton and the latter in a clean or renovated state will be delivered to a chute, from whence it is conducted to a proper receptacle or point.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of the paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

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Inquiry No. 5829.—For machines for making pearl buttons.

AUTOS.—Duryea Power Co. Reading, Pa.

Inquiry No. 5830.—For a machine for making mica lamp chimneys.

For mining engines. J. S. Mundy, Newark, N. J.

Inquiry No. 5831.—For manufacturers of safety pins, also for machines for making the same.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 5832.—For a machine for extracting the fiber from the meat.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 5833.—For a hand machine for twisting wire for fencing.

FOR SALE.—Patents on collapsible umbrella. Box 1125, Omaha, Neb.

Inquiry No. 5834.—For an advertising device by which two endless chains have attached between them sheets of printed matter which are carried around and caused to drop at intervals by a pawl and ratchet.

Handle & Spoke Mchy. Ober Mfg Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 5835.—For manufacturers of sand blast machines.

If it is a paper tube we can supply it. Textile Tube Company, Fall River, Mass.

Inquiry No. 5836.—For makers of small water motors with sufficient power to run a 20-watt dynamo.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 5837.—For makers of incubators.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company. Foot of East 138th Street, New York.

Inquiry No. 5838.—For a retail dealer in fancy woods (foreign and domestic) prepared for the scroll sawyer.

Patented inventions of brass, bronze, composition or aluminum construction placed on market. Write to American Brass Foundry Co., Hyde Park, Mass.

Inquiry No. 5839.—For manufacturers of spring motors.

Sheet metal, any kind, cut, formed any shape. Die making, wire forming, embossing, lettering, stamping, punching. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 5840.—For manufacturers of revolving hand fans.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5841.—For addresses of tin plate mills, also makers of tinners' tools and machinery.

An Expert Mechanic on scientific instruments, etc., who has a laboratory fitted up for accurate work, wishes to meet a party engaged in scientific experiments, mechanical or electrical. Absolute privacy. Highest references. Electrical, 828 Kent Ave., B'klyn

Inquiry No. 5842.—For manufacturers of woodwool, and quotations on the same.

Inquiry No. 5843.—For the address of the designer or maker of any filling or packing machine for packing absorbent material in a paper napkin, and in closing in a rubber band.

Inquiry No. 5844.—For makers of sand blasting machines, for sand blasting glass for signs.

Inquiry No. 5845.—For a motorcycle having a 1½ or 2 h. p. engine.

Inquiry No. 5846.—For manufacturers or dealers in mica.

Inquiry No. 5847.—For a coating machine such as used for photographic papers.

Inquiry No. 5848.—Wanted, information concerning the making of wood alcohol, acetate of lime, etc., in connection with charcoal production.

Inquiry No. 5849.—For maker of aluminum and silver soda-water counter supplies.

Inquiry No. 5850.—For manufacturers of gilsonite and elaterite anti-corrosion paints.

Inquiry No. 5851.—For parties engaged in enameling such as used in tin cans, buttons, etc.

Inquiry No. 5852.—For makerss of accessories for an umbrella factory, such as handles frames, etc.

Inquiry No. 5853.—For makers of centrifugal pumps.

Inquiry No. 5854.—For makers of gasoline engines, patterns and foundry mouldings.

Inquiry No. 5855.—For makers of portable houses or cottages.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9438) W. H. B. asks: Is there any method of preventing a reflection in show windows which have a dark oak backing and are roofed over with wood? At present, a person looking in the windows will see a dim reflection of himself besides the goods, so that they are not displayed to advantage. A. A pane of glass in a show window will reflect an image of a person standing in front of the window when the outside of the window is lighter than the inside. It cannot be avoided except by making the interior lighter than the exterior.

(9439) W. M. H. says: In "Experimental Science," Vol. I., page 407, the formula for Dr. Gassner's dry battery mentions among other ingredients, *plaster*, 3 parts by weight. Would you kindly tell me through your valuable paper what plaster is meant? I hardly think it can be plaster of Paris that is meant. Also what covering is used on this cell, to seal the contents from the action of the air? A. When plaster is called for in the formula for dry cells, plaster of Paris is meant. The cement over the top of the cell may be any rosin, wax, or pitch which will become hard.

(9440) W. S. S. asks: 1. Are the neutralizing brushes on a Wimshurst influence machine used to start the generation of electricity in the machine by friction of the brushes on the sectors as they pass by brushes? If not, what starts the action of machine to generate electricity? A. The origin of the charge of the Wimshurst machine is not well understood. Writers of text-books usually begin the explanation by assuming one of the sectors to have a slight charge of electricity. After that, the course is simple. How this initial charge originates they do not state, since probably they do not know. The only allusion we have seen to the matter is in Ganot's "Physics": "The initial charge is probably obtained from the electricity of the air, or from the frictional resistance against it." It may be so. 2. What length of spark would the above machine give, if it had two 16-inch revolving glass plates, with the usual number of sectors on? A. The length of spark is limited by the distance between the balls on the ends of the collecting combs. If a machine has the discharging balls farther apart than this distance, the spark will jump between these balls and the axle upon which the plates turn. The spark length is usually considerably less than this distance. 3. How would gold leaf do to make the sectors of, instead of tinfoil? A. Gold leaf would answer the purpose of sectors for a Wimshurst machine, though it is not very tough, and would soon wear through by the friction of the brushes. 4. Is there any difference in quality between a 6-inch spark generated by an induction coil and one of same size made by the Wimshurst machine? A. There is a great difference between sparks produced by different sources of electricity. A fine thin spark and a fat thick one are very unlike in their effects. One can, without any inconvenience, receive the spark of an induction machine, but not of an induction coil. There is much more energy in the discharge of the coil.

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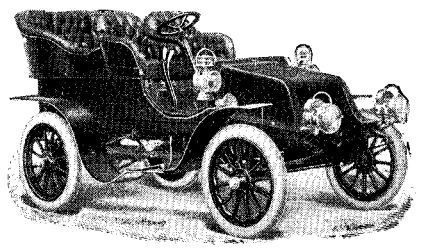
Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

WINTON



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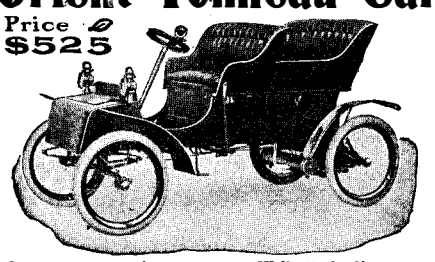

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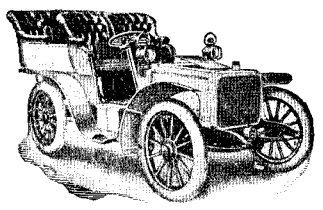

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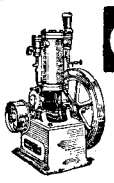

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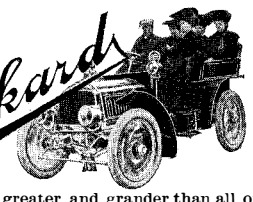

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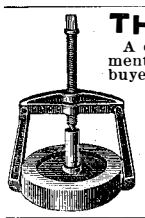

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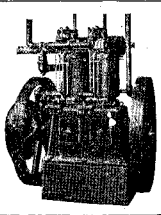

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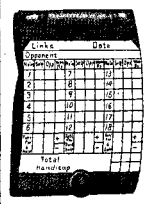

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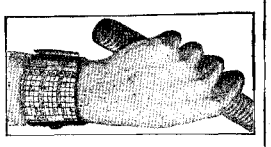

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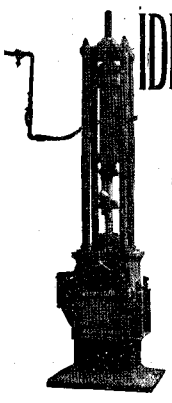

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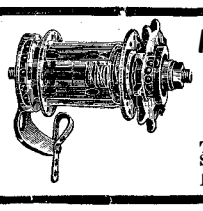

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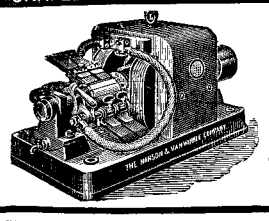

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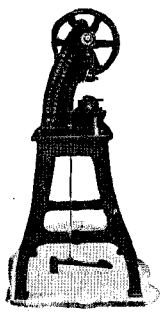

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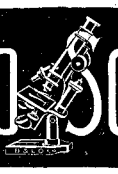

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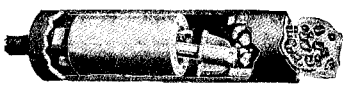

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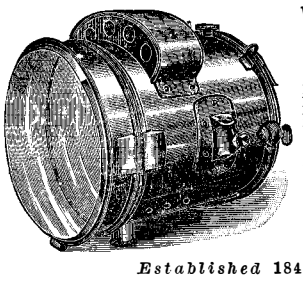

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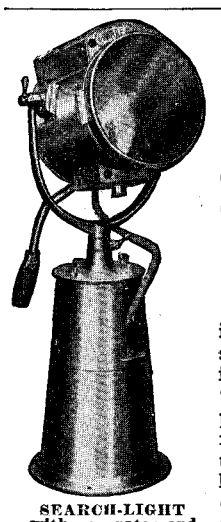

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